

CUNNINGHAMIA

Ecology of Sydney plant species

Part 5 • Flacourtiaceae to Myrsinaceae



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COVER

Plants (clockwise from top left): *Utricularia gibba*, *Gentiana wingecarribiensis*, *Muellerina eucalyptoides*, *Geranium neglectum*, *Isotoma axillaris*, and *Scaevola hookeri*.

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The nature of pre-European native vegetation in south-eastern Australia: a critique of Ryan, D.G., Ryan, J.R. and Starr, B.J. (1995) *The Australian Landscape – Observations of Explorers and Early Settlers*

J.S. Benson and P.A. Redpath

Abstract

Benson, J.S.¹ & Redpath, P.² (¹Royal Botanic Gardens Sydney, Mrs Macquaries Road, Sydney, NSW 2000; ²New South Wales Department of Land and Water Conservation, PO Box 3720 Parramatta NSW 2150) 1997. *The nature of pre-European native vegetation in Australia: a critique of Ryan, D.G., Ryan, J.R. and Starr, B.J. (1995) The Australian Landscape — Observations of Explorers and Early Settlers* Cunninghamia 5(2): 285–328. Based on a selection of quotes from early European explorers and settlers, and modern authors including Flannery (1994), Ryan et al. (1995) suggest that, at the time of European settlement of eastern Australia: the vegetation was mainly composed of grassland and grassy woodland; Aborigines burnt most of the country every year or so; and a lack of fire after European settlement led to thick regrowth that was subsequently ringbarked and cleared by settlers for agricultural expansion. Ryan et al. (1995) present one line of evidence in trying to explain pre-European vegetation and overlook the extensive scientific literature on past and present vegetation, and on fire ecology in Australia. By referring to the scientific literature, and by re-examining the same historical sources used in Ryan et al. (1995), we examine the views of Ryan et al. (1995) and also question hypotheses put forward in *The Future Eaters* by Tim Flannery (1994) and the views about pre-European tree density in *A Million Wild Acres* by Eric Rolls (1981).

The quotes used in Ryan et al. (1995) mainly cover parts of south-eastern Australia between Tasmania and Brisbane, but do not deal with particular regions in a systematic way. They generally refer to one type of vegetation formation — grassy woodland, which mainly occurs on clayey soils in drier coastal valleys, on non-siliceous soils on the undulating tablelands and on the western slopes. The explorers may have favoured travelling through these areas because they occur near rivers (water), had an open understorey and because some explorers were employed to seek out suitable grazing lands. Using three historical estimates of tree density in grassy woodlands, we estimate there was an average of 30 large trees/ha spaced about one tree width apart. This contrasts with Rolls' estimate of 4 large trees/ha and the perceptions of Ryan et al. (1995) about the structure of a woodland. We found frequent references in the explorers' journals to vegetation containing a dense understorey including coastal heath, shrublands, rainforest and dense eucalypt forests. We found no evidence that most of south-east Australia's vegetation was annually burnt by Aboriginal people and provide examples where explorers' notes about fire have been misinterpreted or inappropriately extrapolated by Ryan et al. (1995) and Flannery (1994).

While some journal entries reveal that Aboriginal people used fire for cooking and burning the bush, the extent, frequency and season of their use of fire is largely unknown, particularly for southern Australia. Vegetation types such as rainforest, wet sclerophyll eucalypt forest, alpine shrublands and herbfields, and inland chenopod shrublands, along with a range of plant and animal species, would now be rarer or extinct if they had been burnt every few years over the thousands of years of Aboriginal occupation. Furthermore, Ryan et al. (1995) and Flannery (1994) ignore much evidence that points to climate as being the main determinant in vegetation change over millions of years, with major changes occurring since the onset of aridity in the Miocene but continuing through the last ice age, which coincided with the occupation of Australia by Aboriginal people.

The adaptation of many plant species to aridity, drought, low nutrient soils and fire does not imply a requirement for them to be frequently burnt. South-eastern Australia's native vegetation is now highly fragmented, after 200 years of clearing, stock grazing and weed invasion. Management of what remains of this vegetation should be based on a scientific understanding of the functioning of ecosystems and the population dynamics of a range of plant and animal species.

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Introduction

In 1995 a 20-page booklet *The Australian Landscape — Observations of Explorers and Early Settlers*, prepared by D.J. Ryan, J. Ryan and B. Starr, was published under the name of the Murrumbidgee Catchment Management Committee of Wagga Wagga on the South West Slopes of New South Wales. The authors (p. 1) state that they produced the booklet in order to 'minimise our impact on and improve our management of the environment'. The booklet included a bibliography that contained 97 references of which 25 were cited.

Based on a selection of quotes from the journals of some early explorers and settlers, and from recent treatments including *The Future Eaters* by Flannery (1994), Ryan et al. (1995 p. 1) state that:

There is a common belief that Australia was a vast expanse of thick forest before the arrival of European settlers more than 200 years ago and that there has been massive clearing of that forest land ever since. Unquestionably, the Australian landscape has changed over the last two centuries. But what was it like before then and how has it changed? It is becoming more evident that before European settlement most parts of Australia burnt more or less on an annual basis producing vegetation communities markedly different to that of common belief.

The booklet does not stipulate who holds this 'common belief', as it is clear that 200 years ago most of Australia was covered by semi-arid shrublands, mallee and woodlands, with dense forest restricted to the wetter parts of the eastern coast and tablelands, Tasmania and south-western Western Australia (AUSLIG 1990). Also, while the title of the booklet includes 'Australian landscape' the historical quotes used in the booklet refer mainly to forests and woodlands in New South Wales where European settlement began in 1788.

Ryan et al. (1995) is divided into three main themes: **Fire regimes**, **Forest land and Regrowth**. The authors attempt to show that great tracts of the pre-European Australian vegetation were dominated by open, park-like woodland or grasslands. They postulate that these open grassy woodlands and grasslands were created and maintained by 'fire stick practices' of the Aboriginal people (first mooted by Jones 1969). They also argue that regrowth proliferated after European settlement as a result of the lack of frequent fire, and that the massive ringbarking and clearing over the last century was mainly of this regrowth and that this clearing re-established the landscape's 'original' grazing capacity.

Ryan et al. (1995) have been quoted by those opposed to vegetation clearing control regulations, particularly State Environmental Planning Policy 46 (SEPP 46), which was introduced in New South Wales in August 1995. It has also been used to support more frequent and widespread prescribed burning of vegetation in state forests, national parks and wilderness areas. One of the authors stated verbally that clearing has restored the structure of the vegetation to a similar state to what it was in 1788 (J. Ryan on ABC Radio National *Earthbeat* program, 30 March 1996).

These ideas have been further promulgated in the media. O'Kane (1996) writing in *The Land* newspaper used the booklet to expound such notions that land clearing by farmers is returning the landscape to an original condition of well spaced trees with

a grassy understorey. In another article on this subject published in the *Canberra Times* (O'Reilly 1996), the authors Tim Flannery and Eric Rolls were quoted as stating there are 20% more trees now than in 1788 due to regrowth and cessation of frequent fire.

In light of the public exposure of Ryan et al. (1995) and its possible influence on policies involving the management of native vegetation in Australia (particularly New South Wales), we consider the booklet requires scrutiny as it appears not to have been critically reviewed before its publication. We investigated the validity of its main propositions about fire frequency and vegetation change. This has involved re-examining the accuracy and context of the quotes used by Ryan et al. (1995), examining other reports from the same historical journals, and reviewing the scientific literature on fire ecology and vegetation change in Australia. We also comment on Rolls (1981) views of the pre-European tree density in the Pilliga Scrub and some of the hypotheses in Flannery (1994) about the nature and cause of vegetation change in Australia since Aboriginal occupation and subsequently European settlement.

This critique is divided into the three main themes of the booklet: 'fire regime', 'forest land' and 'regrowth'. An examination of some of the quotes used in the booklet is followed by a brief review of the scientific literature on each theme.

Our definitions of closed forest, open forest, woodland and open woodland follow Walker and Hopkins (1990): 'closed forest' — tree crowns touch or overlap as with most types of rainforest; 'open forest' — tree crowns are either touching or less than one quarter of a crown-width apart; 'woodland' — tree crowns are separated by between one quarter and one crown-width; 'open woodland' — trees are separated by between 1 and 20 crown-widths.

Note: Historical quotes used in Ryan et al. (1995) and re-stated by us are placed in italics, bolded and encased by inverted commas e.g. '*historical*'; original text of Ryan et al. (1995) that we have quoted is placed in italics and bolded e.g. *historical*; other historical quotations we have used that are not in Ryan et al. (1995) are placed in italics only e.g. *historical*. We have quoted from historical journals with the original spelling. This differs from modern spelling for some words and in the names of some plant species.

Fire regime

Ryan et al. (p. 1) hypothesise that:

... before European settlement most parts of Australia burnt more or less on an annual basis producing vegetation communities markedly different to that of common belief.

On page 2 the authors continue:

Nearly every early navigator or explorer mentions fire or comments on the amount of smoke seen. The letters, diaries and journals all indicate that Aborigines always carried a lighted fire-stick and never put a fire out. Consequently, the Aborigines did not just burn now and again, or only in

autumn, or when the birds were not nesting. They burnt all the time. Many thousands of fires were lit across the countryside on a daily basis. In addition there was nothing to stop these fires from spreading when conditions were suitable.

To Aborigines fire was seen as necessary to clean up the country. They regarded unburnt forest or grassland as being neglected. Apparently for most, if not all groups, every part of grassland, savanna and eucalypt woodland of their territory would be burnt regularly, annually, or at least once every three or four years. It was seen as doing duty by their land.

We suggest that the explorers' descriptions of Aboriginal fire practices were not quoted or interpreted in a balanced way by Ryan et al. By examining the same explorers' journals, alternative interpretations can be made about the type and abundance of fire in the landscape. Early navigators such as Cook noted 'smooks' [sic] because he was trying to work out which parts of the land were inhabited as he had instructions to take possession of the land with the consent of the natives (Cook 1770) (see below). Ryan et al.'s statement that all Aboriginal groups burnt regularly implies there were homogenous Aboriginal burning practices across Australia. This will be shown to be false.

Cook (1770) and White (1790)

During his exploration of the east coast of Australia in May 1770, James Cook (1770) observed many Aboriginal fires or what he termed 'smooks'. Ryan et al. (1995) quote Cook's journal as the explorer passed Cape Howe when he noted:

'In the afternoon we saw smook in several places by which we knew the country to be inhabited.'

As Cook sailed up the east coast of Australia after leaving Botany Bay he made other references to fire. On Tuesday 8th May, 1770, just north of Broken Bay near Cape Three Points, Cook (1770 p. 313) noted:

In the pm saw some smooks upon the shore and in the evening found the Variation to be 80° 25' East, at this time we were about 2 or 3 miles from the Land and had 28 fathom of water.

and again on Friday 11th, near Port Stephens Cook writes (p. 314):

We saw several smooks a little way in the Country rise up from the flatland, by this I did suppose that there were Lagoons which afforded subsistence for the natives such as shell fish &c for we as yet know nothing else they live upon.

And on the following day, near Port Macquarie (p. 315):

In the pm as we run along shore we saw several smooks a little way in land from the sea and one upon the top of a hill which was the first we have seen upon elevated ground since we have been upon the coast.

It was from Sunday 13th May, 1770, that Cook appears to detail a larger fire as opposed to the smoke from smaller camp fires. He writes:

At Noon we were by observation in the Latitude of 30° 43' S and Long^de 206° 45' west and about 3 or 4 Leagues from the land (15–20 km), the northermost part of which bore from us N 13° West and a point or headland on which were fires that caused a great quantity of smook which occasioned my giving it the name of Smooky Cape, bore SW distant 4 Leagues. It is moderately high land, over the pitch of the point is a round hillock, within it two others much higher and larger and within them very low land. Latitude 30° 51's, Longitude 206° 54' West. Besides the smook seen upon this Cape we saw more in several other places along the Coast.

This large fire at Smoky Cape may have either been a bushfire, a controlled burn by Aboriginal people, or merely a large gathering of people. Two days later near Byron Bay, Cook notes (p. 317):

At 9 O'Clock being about a League from the land we saw upon it People and smook in several places.

While near Indian Head in south east Queensland, Cook notes fires on the 20th May;

We saw people in other places besides the one I have mentioned, some smooks in the day and fires in the night.

Further north on 23rd May at a place now named '1770', near Bundaberg, Cook noted (p. 325):

As yet we had seen no people but saw a great deal of smook up and on the west side of the Lagoon which was all too far off for us to go by land excepting one; this we went to and found 10 small fires in a very small compass and some cockle shells laying by them but the people were gone.

Of at least 12 references to fire over the month of May 1770, and a distance travelled of some 2000 kilometres, Cook did not refer to widespread burning of the landscape by Aboriginal people. Most of the smooks seen by Cook were probably camp fires used for cooking, as evidenced in the last quote. This point was overlooked by Ryan et al. who portray his observations as proof that Aboriginal people extensively burnt the landscape. Cook's observations are more important in providing evidence that the east coast of Australia was well occupied by Aboriginal people in 1770. They provide little information on the nature of Aboriginal burning practices.

John White (1790), the surgeon on the First Fleet, is quoted on page 2 of Ryan et al. observing a large fire at Storm Bay in Tasmania on 7 January 1788. However, the authors did not refer to an entry by White (1790) when, on the 25th April (White 1790 p. 129), he mentions the role of lightning strikes in causing wildfire:

Near this we saw a tree in flames, without the least appearance of any natives; from which we suspected that it had been set on fire by lightning. This circumstance was first suggested by Lieutenant Ball, who had remarked, as well as myself, that every part of the country, though the most inaccessible and rocky, appeared as if, at certain times of the year, it had been all on fire. Indeed in many parts we met with very large trees the trunks of which and branches were evidently rent, and demolished by lightning.

The following quote from White (1790 p. 129) suggests that Aboriginal people were selective in using fire for hunting. Without some control of the intensity and extent of fire they could have damaged their food resources.

26th. We still directed our course westward, and passed another tree on fire, and others which were hollow and perforated by a small hole at the bottom, in which the natives seemed to have snared some animal. It was certainly done by the natives, as the trees where these holes or perforations were, had in general many knots cut for the purpose of getting to the top of them.

Ryan et al. contains several quotes from Governor Arthur Phillip about Aboriginal burning around the early settlement at Sydney. Several interpretations are possible. Aboriginals used fire as a weapon by burning settlers huts and crops during early years of conflict with European settlers (Reynolds 1981 pp. 108–109). Some fires could have been used as a defence against the expansion of European intruders. Fensham (1997 p.12) lists incidents in Queensland where explorers (including Leichhardt) noted Aboriginal people setting grass alight as they fled from the European intruders. Flannery (1994 p. 221–222) refers to several early explorers who encountered fire being used by Aboriginal people for offensive or defensive purposes. However, with no supporting data, he discounts such fires as being a minor proportion of those witnessed by the early explorers.

Fire and the vegetation of Sydney

Peter Cunningham (1827 p. 43) describes the heath and wildflowers that grew on sandy soil in what is now Sydney's eastern suburbs:

... this spot, where low undulating hills (of rock and sand) lie scattered about in disorderly array, garnished with shrubs in liveries of the freshest green, and flowers of the liveliest hue, cannot fail to impress its beauty on the heart too deeply to be readily forgotten.

The eastern suburbs were covered in heath because their soils are low in nutrients and sandy. There is no evidence the area was dominated by a grassy woodland kept open in its understorey by frequent fire as Ryan et al. (p. 6) suggest covered most of south-eastern Australia at the time of European settlement. Similar heath vegetation occurs today in the sandstone-dominated national parks in and around Sydney (D. Benson and Howell 1990, D. Benson and Howell 1994). This vegetation type is a product of low nutrient soils combined with moderate–high rainfall, an environment that produces shrub-dominated vegetation at temperate latitudes throughout the world (Specht 1979). We discuss the fire ecology of this vegetation below.

It is highly unlikely that a horse could have been galloped through the sandstone vegetation of Royal National Park at the time of European settlement (even after a fire) as purported by a NSW Farmers representative (ABC Radio National *Earthbeat* program March 16 1996). Such a statement is not credible evidence of the historical state of either the vegetation or of the fire regime. This notion was probably derived from Mitchell (1838) where he discusses regrowth 'nearest to Sydney' after settlement. Mitchell does not refer specifically to the land now reserved as Royal National Park. Nevertheless, it may have been possible to gallop a horse through the grassy woodland of the Cumberland Plain to the west of Sydney because this vegetation type, growing on a shale substrate, contains a lower density of shrubs than the Sydney sandstone flora (D. Benson 1992). Aboriginal people may have burnt grassy woodlands such as the Cumberland Plain fairly regularly in patches to attract game

and to ease travel, but at the same time they probably protected rainforest and wet sclerophyll forest from frequent fire to protect food resources such as the yam (Kohen 1996).

Explorations north of Sydney by Oxley (1818) and Leichhardt (1842–44)

The wet sclerophyll forests described by John Oxley (1820) in his traverse of the Hastings River Valley would not have existed if so called widespread clean up burns were as prevalent as suggested by Ryan et al. On the 23rd September Oxley (1820 p. 310) notes:

Numerous smokes arising from natives fires announced a country well inhabited, and gave the whole picture a cheerful aspect, which reflected itself on our minds; and we returned to the tents with lighter hearts and better prospects.

This observation is not that of widespread torching of the landscape, but of individual camp fires.

In a letter to his brother-in-law Schmalfuss Esq. dated 2/2/1844, Ludwig Leichhardt (1842–1844 pp. 718–719), discussed the species diversity of the Australian vegetation and bush fires in south-eastern Australia. Ryan et al. selectively quoted a section of this letter (bolded text).

'When you consider how few different kinds of trees go to make up our German woods and indigenous forests, you'll no doubt be astonished when I say that about 120 of these trees are to be found within the radius of a quarter of a mile. 100 of these belong to the dense, rich mountain and river brushes, whilst 20–25 form open forest'. This forest, unlike ours, can't be named after any predominating tree, the way we speak of pine or fir forest, oak or beech forest, for the 25 kinds of trees are evenly mixed, except where the soil favours some rather than others. 'The ground under the trees, which would be covered with blueberry and whortleberry bushes in our oak forests, is mostly covered with kangaroo grass here,' so called either because it's the favourite food of the kangaroos or because it grows like wheat and oats, and just gets high enough for them to peep over when they sit up on their hind legs and tails whilst they're browsing. 'This grass ripens in October and November, when the ground under the trees looks like an even, sweeping field of oats. In November and December the weather gets dry and the bushfires break out.' They're often a mile wide, and they clear the ground of grass and dead wood as they sweep through the bush. The ashes left behind are like manure to the sweet, tender grass that shoots up as soon as it rains and is eagerly consumed by kangaroos, flocks of sheep and herds of cattle. During the hot months fire can range over hundreds of [square] miles. 'It starts [either] where the blacks have been camping for the night, as all they do when moving on is to pull a brightly burning stick out [of the fire] and keep it smouldering against a piece of bark, so that they can light a fire at the next camp;' or [where] white men have set the dry grass on fire [when] passing on; or [where] settlers have been systematically burning off the old grass to obtain young pasture for their sheep and cattle. I've been told that fire is sometimes caused by the friction between trees and boughs rubbing together in the wind, but I've never seen it and it must happen rarely if at all. 'The blacks know how to produce fire by friction,' particularly by rapidly rotating one stick in a hole in another; 'but it takes too much trouble, so they prefer always to carry fire-sticks with them...'

Ryan et al. (p. 12) have selected passages that do not convey Leichhardt's complete observations of fire in the landscape — notably his reference of the use of fire by early settlers.

Leichhardt (1842–44 p. 544) wrote another letter while travelling north of the Hunter River, New South Wales in October 1842. Ryan et al. (p. 11) quoted from part of this letter:

'During my excursions in the bush my interest in bush fires has often been aroused'. Some people maintain that friction between boughs rubbing together in hot winds sets them on fire, and that falling embers fire the grass. 'Others ascribe them entirely to the blacks,' the timber-getters and the sawyers, 'who light fires all over the place to cook their food and leave them unextinguished'.

In this instance Ryan et al. have omitted the reference by Leichhardt to the timber-getters and sawyers being equally responsible for the setting of fires as the Aboriginal people. The Europeans may or may not have used fire in a similar way as the Aborigines. However, there is evidence from fire scars and historical accounts from the Snowy Mountains (Banks 1989, Pulsford 1991), and charcoal deposits from the Robertson Plateau (Kodela 1997) that fire frequency increased after European settlement.

Similarly, the remainder of the quote was very selectively used. In full it read:

'During the hot summer the grass dries out and becomes highly inflammable, and the leaves of the myrtaceous plants, which are full of essential oils, also get very dry. The consequence is that bushfires quickly spread over enormous areas, though without becoming a danger to human beings'. Because the wind brings a steady stream of fresh air and oxygen, and the smoke extinguishes the flames to leeward, the fire always advances to the wind. I have often watched a red line of fire, which may have been several 1000 paces in length, greedily consuming the dry grasses bowing towards it in the wind, and blazing up with a crackling sound through the Eucalyptus saplings that were in its way. It strips the trees of their foliage but rarely kills them. And, although it leaves a blackened, desolate, wintry, burnt-out area behind it, its effects are quickening, for after the next rains fine young grass springs up, and tender foliage begins to clothe the denuded boughs. I was told that the Aborigines burn the bush over limited areas in order to attract wallabies and kangaroos to the fresh pasture. Others even said, though I think wrongly, that they do it in order to kill snakes, as they've got a great appetite for roasted snake.

This passage contains evidence contrary to the Ryan et al. thesis. Firstly, the reference by Leichhardt to the fire blazing up with a cracking sound through the *Eucalyptus* saplings indicates that a multi-aged vegetation structure was present, rather than a simple 'park-like' stand of large well-spaced trees as suggested by Ryan et al. Some saplings must survive to maturity for a forest to be sustained. Secondly, Leichhardt refers to Aboriginal people using fire on limited areas to promote green pick growth, and thus attract game for hunting. This statement does not indicate that all of the landscape was burnt 'all of the time' or within a season.

Scientific research on fire regimes and their impacts on vegetation and plant species

The spectacular scenes of fire in the Australian bush would have been especially noted by the explorers who came mainly from northern Europe where forest fire would have been a rarer event. However, these records provide poor evidence of the fire regimes (season, frequency and intensity) that existed at the time of European settlement in Australia. There was little or no scientific measurement, or even consistent observation, of Aboriginal burning practices during the early years of settlement.

There are several other sources of information that should be used when reconstructing a past fire regime including:

- Palynological studies, for example, a study of the changes in vegetation in north-east Queensland (Kershaw 1970);
- The study of tree rings (dendrochronology) that provides an insight to fire frequency through charcoal scars, for example, a study of fire scars in subalpine trees in Kosciuszko National Park (Banks 1989);
- A combination of fine-resolution pollen analysis and dendrochronology, for example the study of palaeoecology and palaeoclimatology of the Southern Tablelands of New South Wales (Green et al. 1988);
- Geomorphology, see a review of this evidence for south-eastern Australia in Tulau (1996);
- Ethno-history, for example, a study of Aboriginal fire regimes in relation to food supply in Central Australia (Latz and Griffin 1978);
- Studying the population dynamics of native plants and animals in various habitats to gain an understanding of their tolerance to certain fire regimes over time (Keith 1996), for example, the study of the demography of the shrub *Angophora hispida* which occurs on sandstone ridges near Sydney (Auld 1987).

Drawing on the scientific literature, the popular books *The Greening of Gondwana* (White 1986) and *After the greening: the browning of Australia* (White 1994) summarise changes in Australian vegetation over millions of years and point to climate and edaphic factors as the main determinant in vegetation change. Strong evidence to support this comes from pollen records from cores in the Lachlan River Valley in south-eastern Australia (Martin 1996). These show that rainforest species such as *Nothofagus* became extinct in the inland by the end of the Miocene (5.1 million years before present) and grasses, daisies and some myrtaceous groups increased in abundance during the drier ages of the Pliocene (5.1–2 m.y.b.p.) and Pleistocene (2 m. 10 000 y.b.p.), suggesting expansion of grassy woodland vegetation. Charcoal deposits in these cores increased markedly in the Pliocene suggesting an increase of wildfires well before Aboriginal people arrived in Australia, and indeed, before the evolution of human beings.

Attempts have been made to re-establish Aboriginal burning regimes in Central Australia to assist wildlife conservation (Morton and Andrew 1987, Allan & Baker 1990) because knowledge could be gained from Aboriginal people still living on the land in the region. In contrast, it has not been possible to establish what the Aboriginal fire regimes were in most parts of south-eastern Australia because the Aboriginal people living there were rapidly displaced soon after European settlement.

There has been a long running debate about the relative roles of climate change and Aboriginal burning in changing Australian vegetation over the last 120 000 years — see pages 344–345 in J. Benson (1991), Martin (1996), Kohen (1996) and Tulau (1996). A discussion on the evidence of pre-European fire regimes is provided on pages 28–30 in Williams and Gill (1995).

We consider that Ryan et al., Flannery (1990 & 1994) and Rolls (1981) over-emphasise the role of past Aboriginal burning in determining the structure and species composition of Australian vegetation. A majority of the scientific literature on climate change and Aboriginal burning supports the position first suggested by Clark (1983) that Aboriginal burning may have affected the rate, but not the main direction, of changes in the nature of Australian vegetation during the Pleistocene. At the height of the last ice age, 18 000 y.b.p., temperatures were lower and annual rainfall was half of what it is today (Dodson 1991). Such climatic conditions led to a retreat of rainforest and wet sclerophyll eucalypt forests to refugia and much of south-eastern Australia would have been dominated by grassy woodlands or grasslands until conditions changed after the ice age ended (around 10 000 y.b.p.). *Eucalyptus* forests and rainforests expanded again after that to more or less their current distributions with minor permutations due to fluctuations in rainfall over the last 6000 years. The extreme climatic change of the last ice age may also be the primary cause of the extinction of the megafauna (Horton 1982, Wright 1986) rather than hunting and altered fire regimes as proposed by Flannery (1990, 1994) (see the discussion on Flannery's hypotheses below).

Some evidence from coastal New South Wales supports increased fire frequency over recent millenia. Increased sediment deposition rates (Hughes and Sullivan 1981) and more frequent charcoal deposits in the top layers of sediment cores at Kurnell Peninsula (Martin 1994) support the view that Aboriginal burning may have increased over the last few thousand years — possibly due to technological change in Aboriginal society and/or due to an increase in the Aboriginal population (Kohen 1995). However, the importance of Aboriginal burning on sedimentation is questioned in a review of the literature in Tulau (1996). He considers that there is no conclusive evidence that 'fire stick farming' (Jones 1969) was the main cause of changes in sedimentation and that it is difficult to compare fire regimes and consequent geomorphic response before and after European settlement. Caution is required in interpreting changes in the quantity of charcoal in deposits because much of the work in Australia has not been corroborated by other evidence (R. Bradstock pers. comm.). In a definitive study in a catchment in Minnesota in the United States, Clark (1990) derived corroborated evidence by comparing charcoal lake deposits with 750 years of dendrochronological data (tree fire scars). This research revealed that changed fire regimes are tightly correlated to climate changes in that region.

Pollen samples dating from 6000 y.b.p. taken from a core in a swamp in Ku-ring-gai Chase National Park on the northern outskirts of Sydney (Kodela and Dodson 1989), indicate there has been little change in the floristic composition of sandstone flora in that region over that time. Changes in pollen composition over 3500 years in the region of Wildes Meadow Swamp near Robertson, on the Southern Tablelands of New South Wales, indicate that fire activity and *Eucalyptus* declined about 3000 y.b.p. and rainforest expanded but fire increased again after European settlement (Kodela 1997 pp. 103–105). Settlers may have increased fire frequency and intensity to help clear the land.

Kohen (1996) suggests there may have been a 'struggle' between climate and Aboriginal burning over the last 6000 years as rainfall increased, but as rainforest has expanded during that period in north Queensland (Neldner and Clarkson 1995), Robertson Plateau in New South Wales (Kodela 1997) and in Tasmania (Jarman et al. 1984), it appears that climatic factors have been the main determinant of vegetation composition over that period. However, different factors may have varied in their importance in different places.

One of the weaknesses of Ryan et al. and Flannery (1990, 1994) is that they predicate their hypotheses about vegetation change on the assumption that pre-European Aboriginal fire regimes were more frequent than those used by early settlers. At least for some regions, there is evidence of an increased fire frequency due to the burning practices of the early settlers (Wakefield 1970, Kodela 1997, Pulsford 1991).

Critique of Ryan et al. (1995) views on 'fire regime'

Over thousands of years, Aboriginal people burnt much of Australia's vegetation — there is little argument about that. However, the biological evidence suggests that the frequency of fire (Aboriginal or other) must have varied for different types of vegetation. This point has not been discussed by Ryan et al.

While we agree with Ryan et al. that the explorers' recordings and some scientific studies (for example, Lunt 1991) indicate that Aboriginal people burnt grassy woodland and grassland habitats, there is a lack of detail in the historical journals about the extent and frequency of burning. On available evidence, it is most likely that Aboriginal people burnt in a mosaic fashion for 'green pick' to attract game as recorded by Leichhardt (1842–1844), therefore a patch of grassland or grassy woodland may not have been re-burnt for some time.

If the fires were so frequent across the Australian landscape (a notion initiated by Jones (1969), re-iterated by Flannery (1990, 1994) and strongly portrayed in Ryan et al.), in order 'to clean up the country', then it is highly likely that many of the small to medium-sized fauna that existed in 1788 would not have survived due to a lack of hollow logs and dense ground cover. The extensive literature on the habitat requirements of animals was not canvassed in Ryan et al. Examples include:

- The requirement of Red-necked wallabies, swamp wallabies, bettongs and hare wallabies for ground cover to survive as it contains food resources and provides protection from native and introduced predators (Lunney & O'Connell 1988, Christensen 1980);

- The requirement of the threatened eastern-barred bandicoot for a dense ground cover to build nest sites and to protect it from predators (Mallick et al. 1997);
- The conclusion of Hadden and Westbrooke (1996) that increased complexity in the shrub layer (diversity, cover and height) reflected species richness in the herpetofauna in buloke remnants in north-western Victoria;
- The preference of the western ring-tailed possum for forests where trees are touching so it can avoid travel on the ground that would expose it to predation (Jones et al. 1994).

The last point illustrates that some arboreal animals require dense forest to survive rather than open woodland with sparsely spaced trees. Additionally, the early explorers did encounter dense understorey and fallen logs as revealed from Oxley (1820) describing a forest on the north coast of New South Wales:

We therefore continued along the edge of those valleys, our progress much impeded by the vast trunks of fallen trees in a state of decay, some of which were upwards of one hundred and fifty feet long, without a branch, as straight as an arrow, and from three to eight and ten feet in diameter.

Ryan et al. do not present a review of the scientific literature about the post-fire recovery times of many vegetation types that require decades, or even centuries, between fires to maintain their species composition (Turner 1986, Interim Reference Areas Committee of Victoria 1977). This is particularly relevant for the maintenance of rainforest and wet sclerophyll forests. Different Aboriginal burning practices may have applied to different vegetation types, such as postulated by Clark and McLoughlin (1986) for Sydney sandstone vegetation compared to the grassy woodlands growing on shale on the ridge tops of the Lane Cove Valley or on the Cumberland Plain in western Sydney.

Ryan et al. overlook most of the substantial scientific literature on fire ecology including the dynamic interaction of plants and animals with differing fire regimes. Important sources of literature on fire such as Gill et al. (1994) which contains over 2000 references, are not referred to in the booklet. Also, they do not refer to the numerous scientific papers on fire ecology of the predominantly sandstone vegetation in National Parks near Sydney (for example Auld 1987a, Bradstock 1990, Bradstock & O'Connell 1988). The scientific evidence for the Sydney sandstone flora suggests that repeated, widespread burning at intervals of less than a few years will cause the extinction of a number of shrub species and that recolonisation from unaffected sites occurs extremely slowly (Keith 1996). The Aboriginal people did not burn extensive areas of this vegetation type annually, or even every few years, because if they did many plant species would not now be present. Shrubby sandstone vegetation has not spontaneously appeared during the last 200 years because of a lack of burning. As a generalisation, these shrubby sandstone forests and woodlands require occasional intense fires between 10 and 25 years apart, but with variable inter-fire periods (Bradstock et al. 1995). To maintain species diversity and populations of plant species, fire intervals should be long enough to allow seedlings to mature and seed to be built up in the seedbank before another fire (Auld 1997).

While the 'appropriate' fire regime to maintain all species in a given area is difficult to achieve, modern bushland fire management should take a landscape approach aimed at maintaining species diversity in patches by applying varied fire regimes (Keith 1996).

Forest land

Under the 'Forest land' section of Ryan et al. the authors have interpreted explorers' journals to indicate that the landscape was a continuum of open grassy woodland or grassland. They postulate (p. 6) that:

It seems that much of the tall mixed eucalypt forest with a developed understorey that is a common occurrence these days did not exist at the time of European settlement. Contrary to what is often stated, dense forests did not cover large areas of Australia and the first settlers did not set to and ringbark huge areas. There was no need to. Most of the country was woodland, grassland, savannah or open forest. Grazing was plentiful and there for the taking. Many areas could be readily ploughed.

No explanation is provided for the above assertion made by Ryan et al. that it is 'often stated' that dense forests covered Australia. If the northern savanna of Australia is included in estimates of original vegetation cover, woodland was more common than open forest or rainforest (AUSLIG 1990), and it still composes two thirds of the remaining 156 877 000 ha of tree-covered land remaining today (Commonwealth of Australia 1997). However, south-eastern Australia (about which Ryan et al. concentrate their discussion) contains a higher proportion of dense forest than the remainder of the continent. A key point we make is that there was and still is a range of vegetation types — some containing a shrubby understorey, others with an open understorey.

In our re-examination of the same historical literature we found there are numerous instances where the explorers recorded encounters with dense vegetation, not just grassy woodland.

Cook (1770) and White (1790): vegetation of the coast and Sydney

Ryan et al. (p. 6) use the following quote from James Cook on Tuesday 1st May 1770 (Cook p. 307) to argue that little undergrowth existed around Botany Bay in 1770:

'After this we made an excursion into the country which we found diversified with woods, Lawns and Marshes; the woods are free from under wood of every kind and the trees are at such a distance from one another that the whole Country or least a great part of it might be cultivated without being oblig'd to cut down a single tree; we found the soil every where except in the Marshes to be a light white sand and produceth a quantity of good grass which grows in little tufts about as big as one can hold in ones hand and pretty close to one another, in this manner the surface of the ground is coated in the woods between the trees'.

White (1790) stated that the First Fleet settlers could not find the areas Cook had described at Botany Bay, even though they searched extensively for them. White commented (White 1790 p. 110):

... The fine meadows talked of in Captain Cook's voyage I could never see, though I took some pains to find them out; nor have I ever heard of a person that has seen any parts resembling them.

Cook's observations are open to interpretation. He provides no measurement of the distance between trees and the tufts of grass he observed may have been the less palatable non-grass genera *Juncus* or *Lomandra*. Additionally, it would appear that Cook's observations were often based on seeing vegetation from a distance out at sea, rather than recording at close range. For example, he labelled as 'lawns' the heaths on the coast of what is now Nadgee Nature Reserve on the south coast of New South Wales. This may explain why what Cook recorded and what was actually found by White with the First Fleet at Botany Bay were so different. A possible but unlikely explanation could be that Cook observed the vegetation immediately after it had been burnt and by the time White arrived it had changed. On page 7 of Ryan et al. the authors state:

'Many of the early accounts and journals of the first settlers in NSW made comment, similar to Cook. Only scattered trees and very little scrub understorey existed beneath the tall forests along with grass and fern'.

They proceed to quote from an account by John White (1778 p. 122) of a visit to Dee Why on the 15 April 1788 during the early days of the Sydney colony:

'We rounded this lagoon, and proceeded four or five miles westward, along the banks of a small fresh-water river, which emptied itself into it and had for its source only a swamp or boggy ground. After we had passed this swamp we got into an immense wood, the trees of which were very high and large, and a considerable distance apart, with little under or brush wood. The ground was not very good, although it produced a luxuriant coat of a kind of sour grass growing in tufts or bushes, which, at some distance, had the appearance of a meadow land, and might be mistaken for it by superficial examiners'.

The understorey 'sour grass' was probably a combination of grasses and other grass-like plants such as *Lomandra longifolia* or species of *Xanthorrhoea* (grass tree). Many of these species are unpalatable to stock and this may explain the term 'sour grass'.

Earlier on the same day, White (1788 p. 121) describes a wetland near Manly Cove:

His excellency, attended by Lieutenant Ball of the Navy, Lieutenant George Johnston of the marines, the judge advocate, myself, three soldiers, and two seamen, landed in Manly Cove (so called from the manly conduct of the natives when the governor first visited it), on the north side of the entrance into Port Jackson harbour, in order to trace to its source a river which had been discovered a few days before. We, however, found this impracticable, owing to a thicket and swamp which ran along the side of it.

On the 17th of April, after hiding their tents and the remains of their provisions, White's expedition made a forced march in a westerly direction (White 1788 pp. 124–125):

.... of about fourteen miles, without being able to succeed in the object of our search, which was for good land, well watered. Indeed, the land here, although covered with an endless wood, was better than the parts which we had already explored. Finding it, however, very unlikely that we should be able to penetrate through this immense forest, and circumstanced as we were, it was thought more prudent to return.

Later on the 22nd April, quoted in Ryan et al. (p. 7), White mentions traversing through a forest of enormous trees, free of underwood and then being blocked by 'brush-wood' somewhere west of Sydney. When taken together, these descriptions of the vegetation by White reveal that the vegetation around Sydney contained a mosaic diversity of vegetation with areas of heavily wooded forests (with both dense and open understoreys) and thickets of scrub and swamps. It is not possible to understand precisely what White meant by 'well spaced trees' without measurements.

Anthill (1815): vegetation of the Blue Mountains and Bathurst New South Wales

On page 7 of Ryan et al., Henry Anthill (1815) is quoted describing the landscape near modern-day Bathurst on May 4 1815:

'The country we rode over this day ... was beautiful and open, large tracts of land, without timber or underwood ... At present we saw it to great disadvantage, the greatest part of the herbage of the plains having been destroyed by fire'.

On the way to Bathurst, however, Anthill describes a broader range of vegetation types. For example, on Monday May 1 1815, referring to their passage through 'Clarence's Hilly Range' via Mount Blaxland and 'Wentworth's and Lawson's Sugar Loaves,' Anthill (1815 p. 8) describes *this range is clothed with thick timber and has good feeding for cattle*. On May 2 (p. 8) he describes the country from Cox's River to Sydmouth Valley as *red and black granite, hills heaped upon hills, and rocks upon rocks, with deep gullies between, some with streams running through them, and clothed with woods to their very summits*. On May 3 Anthill (1815 p. 10) describes coming to an extensive plain (O'Connell Plains) after riding approximately 8 miles which Anthill cites as, *a considerable tract of land without a tree, fit for both pasture and cultivation*. He goes on: *Continuing along the banks of the river about 2 miles, we came to another extensive plain called Macquarie Plains, which he stated is the more extensive of the two, and equally good for pasture and cultivation*.

While the land around Bathurst was a natural treeless plain of about 12 000 ha (Croft et al. 1997), Anthill and his party traversed through a number of vegetation formations on their expedition. The ranges to the east of Bathurst were densely forested in 1815, yet Ryan et al. only quote Anthill's description of the open plains near Bathurst.

Croft et al. (1997) compare explorers' descriptions of the vegetation in central western New South Wales with that contained on modern vegetation maps. In a majority of cases there is compatibility between them. They conclude that in the early 1800s there

was a range of vegetation types in the region determined mainly by climate and substrate. Woodland was widespread but its understorey varied from open/grassy to dense shrubs depending on the soil. 'Thick brush' was present in 1813 when Europeans first cross the Blue Mountains, as it is today.

Early explorers may have under-reported on vegetation types where the understorey was dense because such reports may have met with less approval (Croft et al. 1997). Often their reason for exploration was to find new grazing land, so they concentrated on describing land that was 'favourable'. Earlier paintings of open woodlands by John Lewin (referred to on page 8 of Ryan et al.), who travelled to Bathurst in 1815, may be an example of this. Also, it is likely that the early explorers would have preferred open, grassy routes for ease of travel — sometimes following the same travel routes as Aboriginal people along grassy plains adjacent to rivers. An example is the journey of Alan Cunningham from Bathurst to the Liverpool Plains on 15th April 1823. Upon departure from Bathurst, Cunningham (1825 p. 142) stated:

The exceedingly broken sub-mountainous structure of the country at N.E., N. and N.N.W., obliged me to commence my route from the plain of Daby, on the Cugeegong, considerably west of north, in part over a rising forest land, tolerably well watered, lightly timbered, and occasionally interspersed with confined brushes...

Linked to the above point is that most of the early explorers and squatters were mainly concerned with seeking out land suitable for grazing stock, not giving objective descriptions of the look of the landscape and vegetation types. This is illustrated in a quote from page 77 of Curr (1841–1851) while squatting near the Murray River:

But we were just intent on sheep-feed, and not on scenery

Oxley (1820): vegetation of the central-west and north coast of New South Wales

One of the earliest recorders of vegetation was John Oxley (1820) who was assisted by the botanist Allan Cunningham. Oxley and his party trekked from Wellington in central-west NSW, north west along the Macquarie River into the Macquarie Marshes and then east towards the coast at Port Macquarie. On page 8 of Ryan et al. (1995) part of Oxley's journal is quoted as the bold text in the following passage:

'The country we passed through is what is generally known in New South Wales as open forest land,' with occasionally small flats on the river, and north and south of us were detached ranges of a similar description. 'The whole face of the country was abundantly covered with good grass, which having been burnt some time, now bore the appearance of young wheat. Six miles down the river it was joined by a fine stream from the southward, apparently watering a spacious valley. We crossed this and named it Ellenborough River,' in honour of the Chief Justice of England. 'We proceeded about three miles further before we halted at the edge of a thick detached brush' which came nearly down to the waters edge. In this brush was a quantity of fine red cedar trees, affording us reason to hope, that this valuable wood might, as we advanced to the coast, be found in yet greater abundance. This timber generally might be termed heavy, consisting of blue gum, stringy bark, and iron bark, with fine forest oaks...

The following extracts have been taken from the portion of Oxley's journal pertaining to his travels from east of Walcha to Port Macquarie, which roughly follows the present day Oxley Highway.

On September 17, Oxley (1820 p. 301–302) comments on different vegetation types:

We proceeded on an easterly course during this day's journey; and seven miles from Crocker's River crossed a smaller stream running to the north-east. For the first ten miles the country was very poor and badly timbered, with barren stony hills; but from the last mentioned stream, to our halting place, at the end of twelve miles, though the land was hilly the soil was excellent, consisting of rich, dark mould. The hills were particularly rich and thickly clothed with fine timber, blue gum, and stringy bark.

And on 18th September Oxley (p. 303) comments on the transition from open forest to wet sclerophyll forest/rainforest with shrubby understorey:

Proceeding on our course to the east north-east, we did not advance above a mile and a half before a small stream running to the north-east through a very steep and narrow valley obliged us to alter our course more southerly, which we did, and soon entered a forest of stringy bark and blue gum trees of immense size and great beauty. The soil on which they grew was a rich vegetable mould covered with fern trees [* Alsophila australis of Brown] and small shrubs. We found that this part of the country was intersected by deep valleys, the sides of which were clothed with stately trees, but of what kind we were ignorant: creepers and smaller timber trees all of a species not previously noticed by us, grew so extremely thick that we found it impossible to penetrate them. We therefore continued along the edge of those valleys, our progress much impeded by the vast trunks of fallen trees in a state of decay, some of which were upwards of one hundred and fifty feet long, without a branch, as straight as an arrow, and from three to eight and ten feet in diameter. The forest through which we travelled appeared to be an elevated level or plain, and at three o'clock in the afternoon, after proceeding three or four miles to the westward, we cleared the truly primeval forest, and descended into a small valley of open ground, through which ran the stream we had crossed in the morning. Indeed we were not more than two miles south of the place we had quitted. Our hope of proceeding without much interruption was thus disappointed: the gloominess of the weather, and the constant showers that fell, so impeded our view and distorted its objects, that what appeared plain and practicable at a distance of two or three miles, when approached was found impassable. I think it probable, however, that our most serious obstructions will be the thickness of the timber, rotten trees, and creeping plants; the soil is so rich and free from rocks, that I do not think the steepness of the descents will greatly endanger us. The wind, which had been extremely violent all day, was now accompanied by heavy showers; and we thought ourselves extremely fortunate in not being obliged to encamp in the forest.*

As a result of a change in the weather, Oxley (1820 p. 306) noted on the 21st September:

We accomplished seven miles on a south-east by east course, through a very heavily wooded country; the timber generally of the best description, and the soil, with some partial exceptions, was equally good and rich. It was, however, so thickly covered with ferns and bushes among the trees, with vines running from them, that in many places we found it difficult to pass. Our course was accidentally such as to avoid all the deep valleys but two, the descents of which were extremely difficult.

Again, on September 22, due mainly to the ruggedness of the terrain and vegetation, Oxley comments (p. 307):

We had no choice in the route we pursued this day, taking that which appeared most practicable for men and horses: it was a continued ascending and descending of the most frightful precipices, so covered with trees and shrubs and creeping vines, that we frequently were obliged to cut our way through.

On the same day, Oxley also referred to a barrier of thick vines in what could be considered to be a gully rainforest surrounded by wet sclerophyll forest (p. 311):

*After the provisions were brought up, all hands were sent to cut a road for the horses through the brushies which surrounded the bottoms of the steepest ascents, and without which it would have been impossible for them to pass laden; the vines which crossed each other in various directions forming an almost impenetrable barrier. It may seem superfluous to speak of soil and timber among such mountains as these; yet I will say that except where the rocks presented a perpendicular face, and among the highest ridges, the soil was light and good. The timber consisted of blue gum and stringy bark, and forest oak (*Casuarina torulosa*) of the largest dimensions.*

The preceding extracts from Oxley (1820) describe a range of vegetation types varying in both their floristic composition and their structure. They included woodlands, wet sclerophyll forest, rainforest ('brush') and gallery rainforests. Much of the vegetation contained dense undergrowth. Ryan et al., however, only include one quote from Oxley that describes a grassy woodland on the Northern Tablelands. Excluding the impact of clearing and stock grazing, the vegetation patterns described by Oxley match those present today in the Hastings Valley on the North Coast of New South Wales (NSW National Parks and Wildlife Service 1981).

Peter Cunningham (1827): vegetation of Sydney, Southern Tablelands, Hunter Valley

Although Peter Cunningham (1827) was an agronomist, he gives insightful accounts of the vegetation around Sydney. He describes the vegetation of Mrs Macquaries Road in Sydney as a 'closely wooded point.' He goes on to describe the road to South Head Lighthouse where he states (p. 43):

Midway, a road to the left carries you to a rising ground named Bellevue, level at top, and commanding an extensive view of the ocean and all the surrounding wild uatural scenery. The country on the route will afford few charms to the mere agriculturalist, alive to no other attractions save fertility of soil; but to the admirer of untamed nature, in all her primeaval variety, this spot, where low undulating hills (of rock and sand) lie scattered about in disorderly array, garnished with shrubs in liveries of the freshest green, and flowers of the liveliest hue, cannot fail to impress its beauty on the heart too deeply to be readily forgotten.

In this passage Cunningham is describing a heathland on low fertility soils. This contrasts with statements made in Ryan et al. (p. 6) about the dominance of grassy woodlands, some of which could be ploughed.

On page 47, Cunningham (1827) refers to the county of Cumberland and describes the differences in the vegetation between the coast and the Cumberland Plain west of Parramatta:

... the land immediately bordering upon the coast is of a light, barren, sandy nature, thinly besprinkled with stunted bushes; while, from ten to fifteen miles interiorly, it consists of poor clayey or ironstone soil, thickly covered with our usual evergreen forest timber and underwood. Beyond this commences a fine timbered country, perfectly clear of brush, through which you might, generally speaking, drive a gig in all directions, without any impediment in the shape of rocks, scrubs or close forest. This description of country commences immediately beyond Parramatta on the one hand, and Liverpool on the other; stretching in length south-easterly obliquely towards the sea, about forty miles, and varying in breadth near twenty.

It appears that while a gig could be driven through the Cumberland Plain the coastal vegetation was much denser.

Heading further west, Cunningham (1827 pp. 62–63) describes the vegetation of protected aspects of the lower Blue Mountains:

The moment you reach the foot of the mountain, an entire new scene opens upon your view, the country being quite distinct in its general features, as well as in the trees, shrubs, and even birds it produces, from any thing you have seen before in the colony. The tall fern, cedar and cabbage trees; the numerous creeping vines, climbing up and throwing their fragrant tassels of flowers downwards from the tops of the less lofty trees; the luxuriant growth of every vegetable product; with the red-crested black cockatoos, and large-crested blue pigeons peculiar to this district, make you fancy yourself transported to some far-distant tropical region; to which the temperature, as well as the general features of the spot, bear a much closer resemblance than to the moderate latitudes wherein it is placed.

Again, Cunningham (1827 p. 68) outlines the variation in vegetation cover as he moved across the Southern Tablelands of New South Wales. He states:

Lake George is near to the summit of the range dividing the eastern and western waters, being but about twelve miles from the south Fish river, a branch of the Lochlan [sic] running into the great interior marshes. Beyond this lake is the fine open forest of the Argyle, and stretching on south-westerly, beyond the dividing range, much good grazing forest land and downy open country are passed through, until you reach Monaroo Plains.

These are most extensive downs, clear of timber, which from their fertile limestone soil, seem well adapted for agricultural purposes, while their great elevation and southerly latitude must give them a cool climate, every way suited to European constitutions.

Letter VIII in Cunningham (1827 pp. 75–88) describes the vegetation in the Hunter River valley north of Sydney.

Small settlers occupy patches of ground along the alluvial banks of Hunter's River, for about a mile onward; when you come to a thick vine brush of the richest soil, through which the road winds, the ground becoming firm, and the country beyond it of the open forest description.

Continuing, Cunningham comes upon:

the rich alluvial plains called Twickenham Meadows, which consist of a series of rich alluvial flats, dotted lightly over with trees (with good forest land behind) extending through a distance of twelve miles and upwards along both banks of the river, and averaging from half a mile to one and a half broad.

It is from this section of Cunningham's letter that Ryan et al. (p. 8) take their quote (the bold text) when they are justifying their interpretation of the Australian landscape as being like an 'open parkland'. Further describing Twickenham Meadow Cunningham (1827 pp. 80–81) continues:

On disentangling yourself from among the undulating hills and ridges which bound these beautiful meadows, 'one of the richest natural prospects that can well be witnessed presents itself, the flat alluvial lands spread out before you being matted with luxuriant herbage; branching evergreens scattered singly or in irregular clumps; the river winding through the midst; whilst dark foliaged swamp-oaks, bordering with a deep green fringe its steep and grassy banks, and the gently rising hills beyond, thinly clothed with wide-spreading forest-trees, extend in diversified magnificence as far as eye can reach...'

'.... In all these luxuriant plains there is scarcely a superfluous tree to be seen, not often above a dozen to the acre; and patches of acres here and there met with destitute even of one, and only requiring the instrumentality of the plough to produce an abundant crop. It is this freedom from the superfluous timber, which among other things, gives so decided a preference to New South Wales over America, where your capital is often exhausted in making land fit for the plough;' whereas here, you will often meet with enough to serve your purpose, without a farthing of previous outlay on account of clearing.

While it appears that the floodplain and adjoining plain sections of the Hunter River valley were covered with a grassy open woodland, more undulating country was probably covered with a denser open forest. Cunningham would have traversed the less dense vegetation on the valley floor — the path with the least possible resistance. Cunningham's descriptions of the landscape must be interpreted in the light of his intention as he was employed to evaluate the land for pastoralism. So his words probably present an idealised view of what he was trying to sell to future potential landholders and the Government.

In letter VIII of Cunningham (1827 p. 83) refers to the vegetation of the Liverpool Plains:

These plains occupy a space of about sixty miles square, besides branching out among the hills in various directions, all fine rich grassy soil without a tree, excepting where a small woody hill occasionally rises from the bosom of the plain to vary and beautify the prospect. In looking down upon this extensive tract from the summit of one of the overhanging ridges, the country appears to be spread out like a green ocean, of unbounded extent, with clusters of woody islands bespangling its surface.

These treeless plains described by Cunningham above, were mainly restricted to brown and black cracking clay and alluvial soils derived mainly from basalt (Banks 1995) which occur in a small proportion of the southern part of the Northern Tablelands. Surrounding areas would have been forested to varying degrees.

Lhotsky (1835): vegetation on Southern Tablelands of New South Wales

The journals of the botanist explorer Lhotsky (1835) were also consulted by Ryan et al.. Lhotsky travelled south-west of Sydney in January 1834. He had camped at Long Bridge near Liverpool (now an outer suburb of Sydney) on 11th January, from where he commented (pp. 70–71):

The vegetation near the Long Bridge, began already to be very different from the coast vegetation near Sydney. The experience I have as yet obtained, during my Australian travels, enables me to distinguish five systems of vegetation in this country. The coast vegetation from Sydney, South to Illawarra; in these extensive sandy levels and hills, the Epacris, Borronia, Dalvinia, Gompholobium, Xantorrhoea, Hakea, Grevillea, Personia, and such like, are prevalent and characteristic, when of the higher forest trees, scarcely any other than the Eucalyptus are visible. However, I must observe, (as far as I can do on the present occasion), that even this coast vegetation, has a subdivision of very striking character; and this is the vegetation of our rocky gullies. Here, although few springs appear, which feed the small number of creeks we possess, and the periodical or permanent moisture, elicits a series of plants not to be seen any where else in the same geographical localities. In such gullies, or small flats surrounded by such gullies, is the spot where the two sole species of palms we possess, are to be found. Here the Corypha Australis projects its annulated stem, of a hundred feet high; here the Seafortia Nobilis ascends to an equal height, but with a thicker and smoother trunk. The second sort of vegetation which I shall here mention, is the Argyle vegetation, or that with which the grassy hills, flats, and plains of that County, and all congenial places in the Colony abound. Here, almost all the families of the Coast are wanting, and a certain number of others appear, which begin to be mixed with the tribe of the Compositae, the vast quantity of which characterises the extensive downs of the Menero.

In the above passage Lhotsky notes the major botanical differences between the coast and the inland Cumberland Plain. On the 20th January, after camping on the flats near a chain of ponds at Lockyer's Farm, near Mittagong Lhotsky (pp. 90–92) continues:

We started, and proceeded silently through a serene fresh air, surrounded by the beautiful forest land of the Argyle. After a few miles, we passed a number of fine large ponds, around which the forest was more dense, the dark shadow of which reposed like a mystic dream, upon the surface of the quiet limpid waters. We soon reached a place where the road approaches the Wollondilly a second time ... we entered a rather wild forest, from which a lofty range of hills was visible to the N.E., of at least 600 feet in height, and covered with timber. The expectation to reach Goulburn Plains (here commonly called the plains) increased every moment. We reached a little flat at the foot of the above ranges, where two small, but well cultivated farms are situated, and plenty of vegetables were growing about. We again entered the bush, and reached the Wollondilly, whose course was visible to a long extent through a fine open forest land, the verdure of which, contrasted agreeably with the placid waters of the limpid stream ... The plain I saw stretches about five miles in length, and two and a half in breadth, and being an almost perfect level, the very few undulations being unimportant, it is visible to the whole of that distance, extending from N.N.E. to S.S.W. A long range of wooded mountains, about 600 feet high, girt them from N.E. towards S.W. To the S.S.W. another large one of nearly 2000 (feet) in height is visible at a distance of about 40 or 50 miles, and at the S. W. some lower ones appear at near 25 miles distance.

In the above passage Lhotsky is describing a traverse through open forests between modern-day Mittagong to modern-day Goulburn where he recorded a five miles long by two and a half miles wide grassy plain. This reveals that natural treeless grassland was not abundant in the Sydney to Goulburn region. The region was dominated by open forests most of which have now been cleared.

Further south on Lhotsky's expedition he did encounter a large area of treeless plains on the Monaro tableland on the Southern Tablelands of New South Wales (quoted on page 9 of Ryan et al.). This is an important record of what was one of the largest natural grasslands in south-eastern Australia, of which only a small fraction remains in natural condition today (J. Benson 1994, Kirkpatrick et al. 1995). However, based on other reports from explorers and scientific studies of vegetation history (cited elsewhere in this paper), grassland was atypical of the vegetation of south-eastern Australia 200 years ago. It persisted on the Monaro after the last ice age due to the presence of a dry, cold climate combined with heavy clay or clay-loam soils as these conditions are prerequisites for grassland vegetation worldwide (J. Benson 1994). It is unnecessary to invoke fire or herbivory in order to explain such open vegetation formations that develop under these conditions, as Flannery (1990) and Ryan et al. have done.

Leichhardt (1842–44): vegetation in north-eastern New South Wales

Ludwig Leichhardt described in detail the vegetation of the Mount Royal area on the northern side of the Hunter Valley in a letter to Lt. Robert Lynd dated 19th February 1843 (Leichhardt 1842–44 pp. 632–633):

The base of both mountains is covered with forest, the principle tree being the black butt. The westerly flanks are covered with a rich grass, devoid of trees at Piri and with very few ones at Mt Royal. The easterly flanks are covered with a rich brush to the even edge of both mountains; the brush covers even the more expanded top of Mt Royal, though it seems only a loose heap of Ruines. During my stay at the mountain I observed with few exceptions a S Easterly wind. The wind carries the moisture of the sea, which is scarcely more than 50 miles distant to the mountain, and is here the cause of frequent morning mists and of rain. The rain supplies the East side of the mountains with abundant moisture and is so the cause of the rich vegetation, which covers them. At Mt Royal the moisture is perhaps equally attracted and better kept by the loose stones of the top and I explain so the dense brush extending over it. — And oh that you could have been with me in these brushes! A great variety of trees of great height tied together by vines form the body of the brush. Here grows the nettle tree about 80 and 90 feet high with its large leaves, and the noble red cedar (what is its scientific name?) the red Sterculia, the Sassafras, the Ricinus, the Rosewood, the cohiti wood. It will take some time before we find even their real names. It was impossible to get branches from many of them, or to identify bark and leaves. In little gullies, where the waters went down the fern trees grew luxuriantly about 12–15 feet high with long leaves 8–9' (feet) long. [From margin: Underneath it a peculiar plant, if I'm not mistaken a kind of Dorstenia, and Greliola and the common nettle covered the ground.] Polypodium, Asplenium, Aerostichum grew everywhere, mosses hung down in festoons and a species of bird had knowingly made use of them to hide its nest. —

Lichens of various colour covered the rotten and the living trees. The lyre bird, the native Turkey with its peculiar nest of leaves, the Echidna, and many curious animals live here, though I had no means of getting them, I myself being no shot, and having no terrier to find the small quadrupeds out for me.

The preceding passage aptly describes the subtropical–warm temperate rainforest (Baur 1957) on the eastern slope of Mount Royal that persists today as a consequence of rich basaltic soil, high precipitation and an absence of frequent fire (J. Benson 1983). Leichhardt (1842–44) is quoted on pages 11 and 12 in Ryan et al. but the passages they selected from his journal do not include his many descriptions of wet sclerophyll forest or rainforest vegetation. Leichhardt describes these vegetation types again in a letter to Helenus Scott Esq. on the 24th July 1843 (Leichhardt 1842–44, p. 662):

Of all the country from Newcastle to the Condamine, none could be equalled to the Darling Downs, wherever they are sufficiently watered. The country between the Coast Range and the sea which forms a belt about 100 miles wide, has the advantage of plenty of water, though the rather dense forest and the abundance of scrubs renders them less fit for sheep farming. There are however very generally 1500 sheep in a flock which one shepherd is well able to attend to. The vegetation is rich, the turf denser, than in any part of the colony I traversed (you know I did not get to see New England); the grasses are various though the Kangaroo grass (which might perhaps be different in species from that which covers the mountains of the Glendon Estate) pre-dominates.

In the above passage Leichhardt describes dense forest and rainforest ('scrub') on the coastal strip between the mountains and the sea between Newcastle and Brisbane. Most of the species-rich kangaroo grass grasslands on the Darling Downs have since been replaced with crops and introduced pastures.

Leichhardt was a sagacious recorder of vegetation. His descriptions of the vegetation between the Liverpool Plains on the Northern Tablelands of New South Wales and Brisbane indicate the variety of types of vegetation encountered on that journey (pp. 700–702):

The Liverpool Plains are one of those areas that still hold out the hope of something new to the botanist. When I crossed this strange region there were numerous Compositae in flower. I made only a small collection of them because the only paper I had was the newspapers that my several hosts had been kind enough to give me. 'Just imagine your peregrine friend begging for newspapers so that he might collect plants'—The Liverpool Plains have probably been the bed of a chain of lakes that contained numerous islands formed of sandstone and covered with forests composed of many different species of Eucalyptus. The Cypress pine (Callitris) grows here in many places, and the bush huts are built of its timber. I followed the Mokki, the Namoi, the Peel and the Manilla, to spend some time of the source of the Gwider ...

Between the Peel and the Namoi the [character of the] forest changes, and instead of riding between spotted gums, box and narrow-leaved ironbark you enter a forest of silver-leaved ironbark whose leaves are greenish grey ...

Between the Severn and the Condamine the country is flat, covered with forest which is very dense in some places, known to the colonists as brigalow scrub'. The brigalow is a species of Acacia with long, stiff, greyish phyllodes. It is associated with Casuarinas (forest oak), and a good deal of brushwood, [narrow-leaved] ironbark and a species of Banksia — the only one found far from the coast. The soil is very sandy except on small flats near the streams, where it contains more clay and vegetable mould. The apple tree' of the colonists, Angophora lanceolata, grows well on these flats. Just as the brigalow gives character to this part of the country, another species of Acacia, the myall (Acacia pendula) characterises the Liverpool plains and the plains of the Gwydir and the Big River ...

From the Condamine you are on the Darling Downs, undulating, open country, with rich, black, basaltic soil covered with numerous grasses of which one species of Antistheria, the oaten grass, is the staple food of the numerous flocks of sheep ...

When you enter the basin of the Brisbane, you are at once aware of the greater vigour in plant growth. Trees are taller and they grow closer together. The flanks of the mountains and the banks of the streams and of river are overgrown by almost impenetrable brush [mountain brush and river brush].

The above passages describe both open and dense vegetation types in the areas that Leichhardt traversed. Similar vegetation patterns exist today but those on more fertile soils such as Myall *Acacia pendula* and Brigalow *Acacia harpophylla* have been extensively cleared for agriculture.

Curr (1882): vegetation of the Riverina, south-western New South Wales

Turning to the inland plains, Curr (1882 p. 86) comments on the relationships between rainfall, vegetative production and stocking rates on inland vegetation such as the replacement of chenopod shrublands with grasslands on the Riverina:

Originally also, in conjunction with a little grass, large portions of the continent were covered with salt-bush and pigs'-face. In places, as for instance around Mt. Hope and the Terricks, in Victoria, the salt bushes occasionally attained the height of twelve feet, standing twenty or thirty feet apart; in other localities a dwarf variety of this plant prevailed, and grew so close as almost to crowd out the grass entirely. With this class of vegetation great changes have occurred, and at Mount Hope (as in country generally in which it grew), stocking has almost entirely destroyed it. The pigs'-face, once general in that country, has also disappeared, a luxuriant growth of grass having taken its place. The same might be said of the cotton bush and other plants.

This observation that the original vegetation on the Riverina was mainly composed of chenopod shrubland contrasts with Ryan et al. view that grasslands and open understorey woodlands covered most of Australia prior to European settlement. Curr is quoted in their booklet on fire and grasslands (pp. 12–13) but his reference to the original chenopod shrubland of the Riverina is not included. Chenopods are not highly flammable, but if burnt enough they are mostly killed and only recover slowly from seed (Hodgkinson et al. 1993). If fire was as widespread and frequent before European settlement as suggested by Ryan et al., it is unlikely that chenopod shrubland would have been as abundant and as aged (metres high) as suggested in early observations as documented in Moore (1953).

Scientific evidence of pre-European vegetation and vegetation change

The conjecture of Ryan et al. that most of Australia was covered in grassland or grassy forests in 1788 does not fit with scientific evidence about the composition of Australian vegetation since the end of the last ice age 10 000 years ago.

Australia contains a broad range of vegetation types that have evolved over millions of years in response to climatic change, a range of soil types derived from an array of substrates, and the isolation of the continent (although some species from the north did colonise the continent). Most of the soils of Australia contain low levels of nutrients. They have not been renewed through glaciation for 300 million years and only small areas of the east coast have been enriched through volcanism over the last 40 million years (White 1997). Infertile soils, combined with an onset of aridity over the last 15 million years, has led to a dominance of sclerophyllous plant species including *Acacia* and *Eucalyptus*. Rainforest and grassy woodland tend to occur on higher nutrient soils with the former in high rainfall areas protected from fire and the latter in drier areas subjected to fire. The extensive scientific literature on the history of Australian vegetation is summarised in texts such as Groves (1994) and White (1986, 1994). The current vegetation of Australia is described in Beadle (1981) and Groves (1994), and broadly mapped in AUSLIG (1990). In addition, over the last forty years many regional and local vegetation surveys have been compiled at a range of scales to assist with land use decisions and habitat management.

There is no evidence to support the Ryan et al. and Flannery (1994) view that grassland and open woodland covered most of the landscape in 1788, although as mentioned under 'fire regime' above, these vegetation types were more common during the last ice age. Based on studies of pollen from soil cores (for example Ross 1984) grasses appeared to be more prevalent during the last ice age 40 000–10 000 y.b.p. due to cold temperatures and lower precipitation. During the ice age, vegetation change was probably mainly climate-driven and many vegetation types in south-eastern Australia would have retreated to refugia, but have expanded in their distribution again over the last 10 000 years. This includes both rainforests in places such as the Atherton Plateau (Queensland), Barrington Tops (NSW) and Tasmania, and eucalypt forests over the continent generally. Climate change after the last glaciation is probably the main explanation for the rise in eucalypt pollen over grass pollen in many sites after 8000 y. b.p. as trees re-colonised higher altitudes (Singh et al. 1981). This topic is summarised by Dodson (1991), mainly based on studies of pollen in soil cores from a number of regions of Australia.

Aborigines, like the Europeans, favoured some habitats over others, including grassy woodlands and river valleys where water was plentiful. The archaeological evidence suggests that they did not reside in the dense escarpment forests as much as on the coast or on the inland plains (V. Attenborough pers. comm.). During the last ice age the climatic conditions were so severely dry and cold, that Aboriginal impacts on vegetation through burning may have been relatively minor in comparison (White 1997). The topic of Aboriginal burning is discussed above under 'fire regime'. To reiterate, the evidence suggests that climate change was the main determining factor of vegetation change even over the period since Aboriginal people came to Australia.

The vegetation had become physiologically adapted to fire, poor soils and aridity over millions of years. Aboriginal burning may have accelerated the pace of change in vegetation composition in some plant communities, but it is unlikely it initiated the direction of change (Clark 1983).

Regrowth

Ryan et al. (p. 15) state:

The extracts from letters, diaries and journals of early European settlers, explorers and government officials describe a parklike landscape of grasslands and grassed open forest lands with very few areas of thick forest. The cessation of the regular burning following European settlement allowed the growth of a thick forest of young trees that, together with an increasing shrub understorey, choked out the grasses. The widespread ringbarking that was carried out around the turn of the century was mostly of this regrowth. The landowners were attempting to re-establish the original grazing capacity.

Ryan et al. cite several early observations about regrowth (Curr 1841–51, Mitchell 1838 & Howitt 1890). Mitchell (1838) observed regeneration of thickets of trees on the Cumberland Plain west of the early settlement of Sydney. He probably did observe shrub species such as Blackthorn *Bursaria spinosa* increase in abundance due to less frequent fire (D. Benson and Howell 1994). With the onset of clearing for grazing and timber extraction from forests, regrowth of young trees would have occurred in places that were not cultivated or re-cleared over the years.

Howitt (1890) referred to sapling growth in the Snowy River valley and in Gippsland after settlement and to regrowth of *Eucalyptus sieberi* (Ryan et al. p. 14):

'giant trees of E. sieberiana now all dead, while a forest of young trees of the same species ... which may probably be twelve years, growing so densely that it would not be easy to force a passage through on horseback'.

It is not surprising that Howitt observed thick regrowth of *Eucalyptus sieberi* as this species proliferates after intense fires which occur from time to time in the forests of Gippsland. Also, reduced competition from grasses due to stock grazing may have led to increased survival of saplings. Howitt's observations were made 60 years after the European settlement of Gippsland, and Wakefield (1970) argues that the settlers burnt frequently — every 3–4 years. This may have been more frequent than previous Aboriginal burning and it led to a more shrubby vegetation. Similarly, Good (1982) demonstrates that frequent burning of sub-alpine vegetation in Kosciuszko National Park increases the abundance of the flammable shrubs *Bossiaea foliosa* and *Daviesia latifolia* but when these shrubs are left unburnt for 40 years the understorey tends to revert to a sward of snow grass. These studies counter the axiom adopted in Ryan et al., Rolls (1981) and Flannery (1990, 1994) that frequent fire leads to a more open understorey and inhibits shrubby regrowth. The studies also challenge the assumption that Aboriginal people burnt the landscape more often than the early settlers.

Clearing and regrowth in southern Australia

Given that Ryan et al. dedicate a chapter to what they perceive to be the 'problem' of forest regrowth, it is curious that they hardly mention the problems of vegetation clearance, over-logging and overgrazing by domestic stock over the last 200 years (although they imply that clearing or thinning is returning the vegetation to the 'natural state'). These have been primary causes of soil erosion, acidification, rising water tables and salinisation, decline in abundance of native species and species extinction.

The early settlers sought out pastures that required the minimum removal of trees, thus they quickly occupied natural grassland areas such as the Monaro in New South Wales, the midlands in Tasmania and the Keilor Plains near Melbourne in Victoria. Due to over 150 years of stock grazing, cultivation, pasture improvement and weed invasion, these grasslands are now close to extinction (Kirkpatrick et al. 1995). At the time of European settlement, grasslands were scarce compared to forested land and from an early time the settlers began clearing forest and woodland. The rate of forest clearing became a topic of public debate. For example, while debating the first Forestry Bill for New South Wales in 1909 Mr N.R.W. Nielson, Member of the Legislative Assembly for Yass, said (NSW Parliament *Hausard* 1909):

I could take Honorable Members to the country between Narrandera and Barnumdinan and I could point out thousands of acres of valuable cypress pine which have been ringbarked with no other desire than to grow grass. I have been grieved to observe the enormous quantity of beautiful timber which has been wasted in order that the land might be utilised for pastoral purposes ...

Reed (1990) estimated that 35 million hectares, or 44%, of New South Wales was ringbarked or cleared in the first 130 years of settlement. A total of 1 550 000 km² including 52% of the woodlands and forests of Australia's land use zone has been cleared or thinned over the last 200 years (Graetz et al. 1995). There is little evidence to support the views of Ryan et al. that most of the ringbarking was of regrowth. By revisiting sites in inland NSW where the vegetation was described by explorers such as Mitchell, Denny (1992) reveals that at most locations all strata (particularly the understorey) of vegetation have decreased in their biomass due to stock grazing, clearing and logging for fence posts since European settlement. Hundreds of thousands of trees including White Cypress Pine *Callitris glaucophylla* were felled for fence posts in western NSW before steel fence pickets were invented (Denny 1980).

Clearing is still occurring. In New South Wales it has been estimated that an average of 150 000 hectares of native vegetation was cleared annually between 1980 and 1995 (NGGIC 1994) with three times this amount in Queensland during the 1990s.

Soil erosion increased soon after settlers and their stock moved onto the land. In a study of erosion rates into Llangothlin Lagoon on the Northern Tablelands of New South Wales using ²¹⁰Pb chronology dating techniques, Gale et al. (1997) found that the deposition rate of soil into the lagoon increased many fold after the introduction of stock in 1837. In 25 years most of the topsoil was eroded from the catchment.

At the time of European settlement in eastern Australia there were similar vegetation types as there are today — ranging from rainforest to dense eucalypt forests to open woodlands. The early settlers favoured woodlands where the trees were well spaced and grasses and herbs dominated the ground cover. In south-eastern Australia woodlands grow on relatively rich loamy or clayey soils in drier coastal valleys, the tablelands and western slopes of the Great Dividing Range and parts of the inland plains. Examples include the Grey Box *Eucalyptus moluccana* — Forest Redgum *Eucalyptus tereticornis* woodland of western Sydney (D. Benson 1992) and the grassy box woodlands dominated by White Box *Eucalyptus albens* on the western slopes of New South Wales (Prober 1996). These temperate woodlands of southern Australia have taken the brunt of agricultural expansion — including recent broadscale clearing. Of the bushland cleared during the 1980s, 71% was woodland (World Wide Fund for Nature 1996). Woodlands are also threatened by firewood cutting, overgrazing, weed invasion, rising water tables and salinity.

While large tracts of country have been cleared, cultivated or subjected to pasture improvement, other areas have only been grazed and not cleared, allowing some native species to persist. In some places regrowth of forest has occurred after the initial clearing — often on public lands, poorer soils, steep slopes or in back paddocks distant from the main production zone of a farm. Regrowth after disturbance is more dense than the original forest or woodland but over time it self-thins. In the absence of further major disturbance it eventually becomes dominated by large, spaced trees. An example is Coolibah *Eucalyptus coolibah* — Blackbox *Eucalyptus largiflorens* woodland that grows on the floodplains of western New South Wales. Many of these floodplains have been extensively cleared and others are threatened with clearing or thinning of regrowth as there is a perception among the pastoral community that the 'original forest' was 'park like' and regrowth is unnatural (Maher 1995). Seedlings of Coolibah germinate after floods, so it is possible to age cohorts of trees in relation to flooding history. By counting the number of Coolibah trees in plots placed in different cohorts of trees that germinated after different floods between the 1890s to the 1950s, Maher (1995) found that after 100 years less than 3% of the trees remained. This illustrates that regrowth is a natural phenomenon and the structure of a woodland changes over time through self-thinning. Grazing in these woodlands may actually favour tree seedling survival because it reduces competition from other plants such as grasses if they are grazed in preference to eucalypt seedlings (Maher 1995).

For forests to survive over time it is necessary for young saplings to be recruited to the population of mature trees (eucalypts live 200–500 years). Most eucalypt saplings, however, would not have survived the frequent, even annual, burning regime postulated in Ryan et al. to have been applied across the landscape prior to European settlement.

Other Contemporary Writers

The popular books of Rolls (1981) and Flannery (1994) appear to have influenced Ryan et al. about the nature and causes to vegetation change in southern Australia since European settlement. Flannery (1994) is quoted several times by Ryan et al. to support their conclusions.

A Million Wild Acres (Rolls 1981)

It would seem that the popular book *A Million Wild Acres* (Rolls 1981), either directly or indirectly, influenced the views of Ryan et al. about pre- and post-European forest structure in south-eastern Australia. Rolls (1981) records his views of post-European history of the 400 000 ha Pilliga Scrub, a forest growing on low nutrient sandy soils in central, north-western New South Wales near the town of Coonabarabran. This case illustrates how generalisations about vegetation structure should not be applied to all parts of a forest or a region, and how popular views should be substantiated by more detailed studies of historical records and species dynamics.

According to Dodson & Wright (1989) climate has been the major cause of change in the vegetation of the Pilliga Scrub. Their analysis of pollen records shows that at the height of the last ice age, 25 000 y.b.p., the Pilliga Scrub probably contained few trees and was dominated by chenopod shrubs, daisies and grasses in a semi-arid environment. The present type of vegetation of *Callitris* and *Eucalyptus* forest established in the Holocene (10 000 y.b.p.–present).

Rolls (1981 p. 1) states that:

Australia's dense forests are not the remnants of energetic clearing, they are the product of one hundred years of energetic growth.

On page 1, Rolls refers to Oxley (1820), who was the first explorer to traverse the Pilliga Scrub region in 1818. Rolls does not directly quote from Oxley's journal, but puts his own interpretation of what the pre-European Pilliga Scrub looked like (Rolls 1981 p. 1): *Most of it, about 800 000 hectares, was a 'forest' of huge ironbarks and big white-barked cypress pines, three or four of them to the hectare.* Rolls (1981 p. 1) continues: *We would not now call it forest. 'But that is open grassland' we would say in bewilderment.*

Again on page 245 Rolls states:

*When the first squatters sent their stock in, the ridgy country on the east and south carried the same heavy growth as it does now ... Not all the growth extended to the flats, not all the ridges were covered. The rest, apart from the great arc of Brigalow in the north, was grassland dominated in the east by three to four big ironbarks (*Eucalyptus crebra*) to the hectare, and in the centre and west — about half a million hectares — by three to four big pines to the hectare.*

To check Rolls' descriptions we examined Oxley's journal. After leaving the Macquarie River, Oxley traversed eastwards through the present Day Warrumbungle National Park. He climbed Mt Exmouth which forms part of the Warrumbungle Range and lies in the Park today. From its summit he viewed the Nandewar Ranges

to the north east. The Pilliga Scrub lies between these two mountain ranges. Oxley entered the south-western side of the Pilliga Scrub on August 11, 1818 and left its eastern side on about August 24 1818 (Oxley 1820 pp. 264–272). Winter rains impeded his progress and his expedition often became bogged in the loose sandy soil. He describes a variety of vegetation types: apple tree flats with pine, iron-bark and box (p. 265), pine and eucalyptus on rocky crags (p. 266), a vast variety of flowering shrubs (p. 267), a thick forest of small ironbarks that had been burnt (p. 268) — and states *so thick was the forest that we could hardly turn our horses* (p. 269). Oxley complains about the lack of nutritious grass — referring to a lack of feed for his horses on page 269 of his journal — *it was the fourth day that they had been without grass, and they preferred the tender branches of shrubs ... to the prickly grass.*

In his descriptions of the Pilliga Scrub, Oxley does not mention that large sections of it were 'grassland' as alluded to by Rolls (1981). On the contrary, Oxley describes the Pilliga as a desolate place with a variety of vegetation types and generally a poor grass cover. As mentioned above he even describes thick patches of small ironbark trees. Oxley (1820) mentions grasslands only when he travels further east onto the northern tablelands, particularly when viewing the Liverpool Plains, which we agree were covered in grassland and open woodland.

Oxley (1820) gives no estimates of the number of trees in a given area. The source of Rolls' (1981) estimate of three or four large trees/ha is not given in his book and appears to be a gross under-estimate of the density of large trees in the Pilliga 200 years ago. We consider Rolls' unsupported figures of tree density in the Pilliga has influenced the perceptions of some modern-day writers such as Ryan et al.

Recent counts of large, old (100+ years) trees in the central section of the Pilliga Scrub reveal that there are more than four large trees/ha (E. Norris pers. comm.). The majority of the early grazing runs in the Pilliga were along the rivers on the forest's edges (Norris et al. 1991) where the soils are more clayey than the central sandstone area. These valleys would have contained a more open woodland than that of the central area. Perhaps Rolls (1981) assumes this type of woodland extended over large sections of the Pilliga Scrub. We contend that, even in these more open woodlands, there would have been more than a few large trees per hectare, given the spacing of trees in woodlands generally in south-eastern Australia (Fig. 1).

Rolls may have refined his 1981 views on the density of trees in the original Pilliga forest. In a newspaper article on the impacts of the December 1997 bushfires (Rolls 1997), that burnt 200 000 ha of the Pilliga forest, Rolls states that under Aboriginal management there were three to four huge, old grey trees to the hectare only, with a dozen or so young trees coming on to replace them. He does not define the size of a 'young' tree, but the statement 'with a dozen or so trees coming on' was not stated in his influential book (Rolls 1981). This is unfortunate because it is a better description of the forest. Given the evidence about the spacing of trees in woodlands as outlined below, we contend that there would have been 30 mature/large trees per hectare in the Pilliga with denser forest in some parts.

Rolls (1981) suggests that dense regrowth of White Cypress Pine *Callitris glaucophylla* is not usual and has been caused by a combination of a lack of Aboriginal burning, loss of native herbivores (rat kangaroos), control of rabbits in the 1950s, above

average rainfalls in the 1880s and 1950s, and large fires that stimulated *Callitris* seeds to germinate. Norris et al. (1991) questions some of these explanations of change in the forest. Old surveyors' maps and Oxley's journal (see above) suggest that the central sandstone area of the Pilliga contained a shrubby understorey and patches of dense forest well before European impacts had affected the area. This area still supports a shrubby understorey today.

Disturbance in the Pilliga Scrub due to logging, and timber stand improvement of selectively removing eucalypts, over the last 100 years has probably established favourable conditions for White Cypress Pine seedling regrowth. The presence of mixed age classes of White Cypress Pine suggests there has been some regeneration between the two main regrowth events. Since seed viability falls to 1% several months after seed-fall (Lacey 1972), some seed must have successfully germinated and grown into trees to have yielded the mixed age classes present in the forest.

The major White Cypress Pine regrowth events in the Pilliga Scrub of the 1880–90s and 1950s coincided with above average rainfall years. These may simply be natural patterns when viewed over hundreds of years. This is supported by a study of recruitment of *Callitris glaucophylla* at Roxby Downs in South Australia by Read (1996) who demonstrated that, for seedlings to survive to mature adults, several seasons of above average rainfall are required.

The Future Eaters (Flannery 1994)

At the beginning of the 'forest land' section, on page 6 of Ryan et al., the authors quote from the book *The Future Eaters* (Flannery 1994) to support their presumptions about vegetation change.

The hypotheses about vegetation change and fire ecology in Flannery (1994) were first published in Flannery (1990) and in summary they are:

- Aboriginal hunting pressure was responsible for causing the extinction of the megafauna over 30 000 years ago and also for subsequent dwarfing of remaining mammals (Flannery does not accept evidence from some sites that some megafauna survived into the Holocene, <10 000 y.b.p. He considers these sites contain redeposited material);
- Without the herbivory of the megafauna there was a build-up of fuel across Australia which led to larger fires than before;
- Aboriginal people adjusted to this changed environment by frequently burning to reduce fuel levels and this led to the development of open grassy ecosystems to which many animals adapted;
- The displacement of Aboriginal people by European settlement led to a suppression of burning, fuel build-up and intense bushfires. This changed fire regime was the primary cause of a type of 'aftershock' where large numbers of mainly medium-sized mammal species became extinct in Australia.

Responses by eight reputable scientists to the hypotheses of Flannery are published in Flannery (1990), as is Flannery's reply to them. The majority of these scientists highlight flaws in Flannery's arguments. Some question his assumptions about the

timing of the megafauna extinctions, his emphasis on changed fire regimes as the primary cause of mammal decline since European settlement, and his views of the degree of vegetation change based on pollen/charcoal evidence.

If some of the megafauna survived into the mid-Holocene (6000 y.b.p.), as dated by Wright (1986a), then Flannery's hypothesis about Aboriginal fire regimes keeping regrowth in check collapses. Steve Morton (in Flannery 1990) points out that Flannery did not take into account the impact of stock and rabbits as factors in the recent decline of central Australian arid zone fauna, much of which tended to live in discrete areas containing higher soil fertility. David Horton (in Flannery 1990) argues that Aboriginal burning was more of a substitute than an addition to fire regimes and that other species of herbivores such as insects and smaller mammals could have filled the grazing niche left by the extinction of the megafauna. Horton also points to a contradiction in Flannery's acknowledgment of the importance of late successional stages of vegetation for some fauna. Constant burning as proposed by Flannery would have eliminated late successional stages. Also, some of this megafauna could have been restricted to open plains, similar to extant African megafauna. If this was so, the Australian megafauna would have had minimal effect on the undergrowth of forests on the eastern escarpment and coast.

The popularity of *The Future Eaters* has led to uncritical public exposure of some of the book's more contentious viewpoints, that are mostly conjecture and not based on empirical evidence. Flannery cites changes in pollen types and increased charcoal deposits from sediment cores off the Queensland coast, the Atherton Tableland (northern Queensland) and Lake George (New South Wales) to support his view (Flannery 1994 p. 224):

... we now know that until the last 100 000 years or so, rainforests blanketed vast areas of eastern Australia. They may also have been extensive across the north of the continent ... Researchers have thus had to face the possibility that not only did the arrival of the first Aboriginal people dramatically alter Australian's fauna, but that it transformed its flora also.

Flannery (1994 pp. 218–219) is quoted in Ryan et al. (p. 6) as observing warm temperate rainforest and dense eucalypt forest below a cliff at Bulli south of Sydney. He suggests that in the absence of fire this has replaced grassy woodland seen there by Cook and Banks in 1770. Flannery ignores the fact that both types of vegetation occur in close proximity at Bulli today. The boundaries of the rainforest may have expanded or retreated but the extent of this has not been measured over recent years. Since Flannery could not have known that the area he observed was exactly the same piece of land observed by Cook and Banks in 1770, his inference about vegetation change may not be valid.

While the use of fire by Aboriginal people may have reduced rainforest distribution, there is no evidence that rainforest blanketed vast areas of eastern Australia at the time of their arrival. Rainforest apparently rapidly declined in Australia in the mid-Miocene 15 million years ago (Martin 1996). By 100 000 years ago it probably occurred in patches more or less where it was present at the time of European settlement – confined to rich soils, of the Illawarra, Dorriggo and Richmond–Tweed Rivers (Big Scrub) in New South Wales with dry rainforest in fire-protected

sites in the inland; protected valleys in Tasmania and Victoria; on the wetter sections of the coastal plain and highlands of tropical Queensland with dry scrubs in fire-protected sites inland; and in patches where soils and hydrological factors were favourable in the Northern Territory. Patches of rainforest must have been present on the southern tablelands of New South Wales 60 000+ y.b.p. because rainforest species pollen are present in the Lake George sediment cores (Singh et al. 1981). Rather than dwell on Aboriginal burning as a sole cause of its demise, it is at least as plausible to explain rainforest extinction in some regions as being due to climate change, which led to a natural increase in fire frequency (Horton 1982). During the last ice age (40 000–10 000 years ago) rainforest retreated but has re-recolonised suitable habitats over the last 10 000 years.

At least two thirds of the rainforest in eastern Australia was cleared after European settlement (Werren & Kershaw 1984). In the Northern Territory where fire remains a frequent event, it is thought that edaphic factors (soil type, hydrology), rather than fire-history explains the presence of rainforest among the predominant savanna eucalypt woodland (Bowman 1988).

Flannery is quoted in O'Reilly (1996) as stating that:

Until the time the white man arrived, Australia was a vast grassland, extending from northern Queensland to Victoria with trees only scattered and well spaced, the soil rich in species of wild grasses and flowers.

Grasslands with only scattered trees did not cover all of south-eastern Australia 200 years ago (AUSLIG 1990). Flannery's statement could apply to part of the landscape where grassy woodlands predominate in coastal lowland valleys, some tableland areas, western slopes and sections of the inland plains. Given his previous statement above about rainforest, presumably Flannery considers that Aboriginal burning transformed rainforest areas to open woodland over the last 100 000 years. This is not substantiated by the scientific literature as summarised in Groves (1994) or the pollen records quoted elsewhere in this paper. Nor is it supported by many entries in the journals of the early explorers that describe a mosaic of vegetation types during their travels — as has been discussed above.

Horton (in Flannery 1990) warned that:

The subjects of extinctions and fire are not simply esoteric topics for academic debate, but have serious ramifications for the environment today I don't believe in Flannery's 'trophic cascade' but it certainly has the potential to start an anti-conservation crusade.

This prophesy was realised with the publication of Ryan et al. Flannery's (1990) unproven hypotheses, popularised in *The Future Eaters* (Flannery 1994), fitted well with Ryan et al's view of vegetation change and land management in the Australian landscape.

Perceptions about the structure of woodlands in southern Australia

Understanding the perceptions that Ryan et al., Flannery (1994) and Rolls (1981) have of the structure of pre-European vegetation is important in understanding their philosophy about vegetation management in relation to fire and regrowth. Both Ryan et al., and the frequently quoted writings of Flannery and Rolls, state that the pre-European vegetation cover over much of Australia (including the wetter climes) contained trees 'well spaced' with a 'park like' appearance. They do not quantify what 'well spaced' or 'park like' mean in terms of number of mature trees per unit area. However, based on Rolls' estimate of four trees/ha and comments by Flannery and Rolls in the media (O'Reilly 1996), it appears their perception of a pre-European woodland in southern Australia was that it contained trees several crown-widths apart with little undergrowth present other than a ground cover of grasses. It was similar to contemporary scenes of scattered trees in a farm paddock. J. Ryan confirmed this on ABC Radio National (*Earthbeat* 30 March 1996).

On page 6 of Ryan et al. the authors state:

'Contrary to what is often stated, dense forests did not cover large areas of Australia and the first settlers did not set to and ringbark huge areas. There was no need to. Most of the country was woodland, grassland, savanna or open forest. Grazing was plentiful and there for the taking, many areas could be readily ploughed'.

This perception has led to controversial statements that clearing has 'restored' the landscape to its original tree density. Trees are widely-spaced in some northern savanna regions bordering semi-arid regions, and on the inland semi-arid plains and floodplains of southern Australia, although thick eucalypt and acacia regrowth may occur after floods. However, forests were and remain more dense on the coast, tablelands and western slopes of south-eastern Australia.

The only evidence provided by Ryan et al. that quantifies the spacing of trees in a woodland in south-eastern Australia comes from page 81 in the journal of Peter Cunningham (1827). Cunningham was visiting various properties in the upper Hunter Valley in New South Wales soon after settlers had arrived there and describes the scene (Ryan et al. p. 8):

'In all these luxuriant plains there is scarcely a superfluous tree to be seen, not often above a dozen to the acre; and patches of acres here and there met with destitute even of one, and only requiring the instrumentality of the plough to produce an abundant crop. It is this freedom from the superfluous timber, which among other things, gives so decided a preference to New South Wales over America, where your capital is often exhausted in making land fit for the plough'.

A dozen (12) trees to the acre, referred to in the above quote, is equivalent to 30 trees/ha. If we assume these were large woodland trees, as most likely they would have been on the plains of the Hunter Valley, their average crown-widths would have been at least 10 metres. This is based on our estimations of the crown-widths of large trees in the area today.

Fig. 1 provides a visual representation of the spacing of 30 trees plotted on a 10 metre grid covering an area of one hectare. It shows that the trees on average are approximately one crown-width apart and cover about 30% of the area. This would be classified as a 'woodland' bordering on 'open woodland' using the crown cover based classification of Walker and Hopkins (1990). It would be a 'woodland' under the projective foliage cover based classification of Specht (1970).

These grassy woodlands were much denser than a modern rural scene of a farm paddock with a scatter of aging trees, however they were less dense than many remnant regrowth forests that will take decades to self-thin.

In a study of pre-European tree densities of lowland plains in Gippsland, Victoria, using historical maps, Lunt (1997) found that tree densities varied from 2–59 with an average close to 30 trees per ha. The explorer Evans (quoted in Croft et al. 1997) estimated 10 trees per acre (25 trees/ha) on a plain near Bathurst. Both of these estimates support Peter Cunningham's estimate for tree density in a grassy woodland. These woodlands were not similar to a semi-arid savanna in their structure using accepted classifications of Australian vegetation.

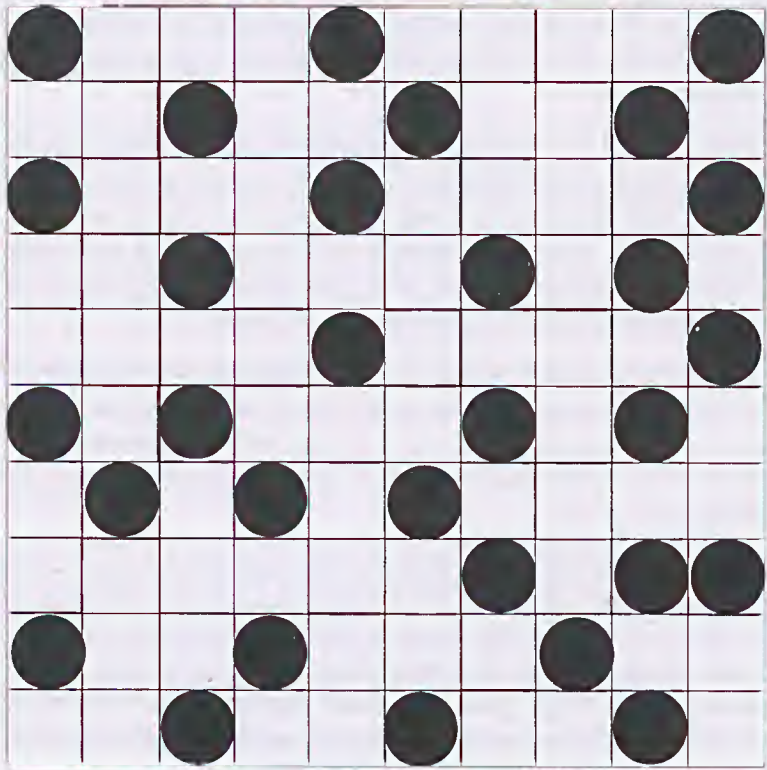


Fig. 1. Interpretation of the spacing of trees in a typical grassy woodland of south-eastern Australia prior to European settlement. The plotted spacing of tree crowns is based on estimates of 10–12 trees/acre (approximately 30 trees/ha) by Evans 1815 (quoted in Croft et al. 1997) for woodland near Bathurst, Peter Cunningham (1827) for woodland in the Hunter Valley and Lunt (1997) for woodland on the Gippsland lowland plain. It is assumed that trees were mature and the width of their crowns would have been approximately 10 m in diameter. Eucalypt forests with touching crowns and rainforest with overlapping crowns would have been present in wetter regions, as they are today.

Oxley (1820) described the forests of the Northern Tablelands of New South Wales as being 'park like' in appearance. In his study of the original forests of the Northern Tablelands, Curtis (1989) considers the gaps between trees would have been one half to one and one half tree-crowns. This fits with both Walker and Hopkins (1990) and Specht (1970) classifications of 'woodland'. Curtis (1989) discusses the history of ringbarking and fire regimes in the region. Clearing began in the 1840s and by 1890 over 400 000 ha of the region had been ringbarked. Subsequent grazing by stock, combined with frequent burning by the early settlers, led to a reduction in diversity of understorey shrubs and seedling trees (Curtis 1989). Norton (1971) considers that European burning differed from the previous Aboriginal burning and it may have eliminated some native legumes. While there has been substantial regrowth of some types of forest on the Northern Tablelands, particularly stringybark (J. Benson & Ashby 1996), many isolated paddock trees (notably Yellow Box, Blakely's Red Gum and New England Peppermint) have suffered from dieback caused by insect attack and other factors (Nadolny 1995, Landsberg and Wylie 1988).

The degree of recent dieback events along the tablelands of New South Wales may have been exacerbated by land clearing and pasture improvement. The aging, widely-spaced trees that are now a common scene in the rural countryside are particularly susceptible to insect infestations and other contributing factors associated with dieback. If there was a similar structure of woodland prior to European settlement in southern Australia, as portrayed by Flannery (1995), Rolls (1981) and in Ryan et al. (p. 2., p. 15 quoting Blainey), then one would expect that dieback may have been a major disease in the pre-European forests and woodlands. Norton (1886) recorded grubs and beetles infesting New England peppermint and manna gum on the Northern Tablelands of New South Wales, albeit after 40 years of stock grazing. However, if trees were as isolated before European settlement as perceived by Ryan et al., its impacts should have been more widespread and conspicuous, yet it is rarely mentioned by the early explorers.

Based on Cunningham (1827), Curtis (1989), Lunt (1997) and the estimates of Evans in 1815, it can be concluded that the spacing of the pre-European grassy woodland trees in the valleys and tablelands of south-eastern Australia was between half a crown-width and two crown-widths apart (Fig. 1). In addition, there were, and remain, tracts of denser forest — open forest and rainforest spanning the coastal plain, eastern escarpment and parts of the tablelands of eastern Australia from Queensland in the north to Tasmania in the south. During pre-European times (as today) these open forests and rainforests would have consisted of dense stands of trees, often with overlapping crowns (NSW National Parks and Wildlife Service 1995).

Conclusions

The following conclusions relate to the main sections in Ryan et al. (1995).

Fire regime: The substantial volume of research on fire ecology (reviewed in Keith 1996 and Williams & Gill 1995) does not support the central thesis of Ryan et al. that most of the landscape was burnt every year or so before European settlement.

Gaining an understanding of the fire ecology of a landscape and its constituent species is extremely complex and requires detailed studies of the life histories of a range of plants and animals and studies of palynological evidence. Many Australian plant species have adapted to increased aridity, low nutrient soils and increased fire over the last 15 million years. No species is adapted to fire per se (Gill 1981). Each species may be adapted to a range of fire regimes. For many species, these regimes do not include repeated high frequency fires. While we acknowledge that fire frequency may have decreased in some places since European settlement, to the detriment of some species (eg. species in grasslands and grassy woodlands), elsewhere the early settlers and modern farmers may have increased fire frequency to the detriment of other species.

Fire frequency may also have increased in some forests due to modern control-burning practices, and this may now be threatening a wide range of species in temperate forests of southern Australia. Compared to southern Australia fires are more frequent in the sorghum-dominated grassy woodlands of the 'top end' of the Northern Territory. Season of burning is an unresolved issue for the 'top end'. There is some evidence that Aboriginal people previously burnt these grassy woodlands patchily in the early or very late periods of the dry season, rather than in driest periods (August–October) as is happening today, and which is leading to annual high intensity grass fires (R. Williams pers. comm.).

In light of a paucity of data on pre-European burning and the fragmented nature of the natural southern Australian landscape today, modern fire management should be based on scientific understanding of species and their habitats (Williams & Gill 1995), rather than on selective interpretations of some of the early explorers' observations. The omission of other sources of evidence, renders Ryan et al.'s discussion of the 'fire regime' topic highly deficient.

Notably, the interpretations espoused by Rolls, Flannery or Ryan et al. have not gained currency in the peer-reviewed scientific literature.

Forest land and regrowth: While we agree with Ryan et al. that the vegetation in large parts Australia has been altered since European settlement, we disagree with their interpretation of this change — that there has been a dense regrowth of vegetation as a result of a decreased fire frequency due to a lack of Aboriginal burning. Vegetation varies from site to site in response to a range of factors, as Croft et al. (1997) demonstrate for the central western region of New South Wales. Ryan et al. appear not to appreciate this.

South-eastern Australia was not completely covered with 'well spaced' trees or treeless grasslands 200 years ago. Ryan et al. ignore the plethora of references by the early explorers and settlers to dense scrub and forest. The perceptions of Ryan et al. that large areas of pre-European woodlands were composed of trees many crown-widths apart (akin to a semi-arid savanna) are supported by neither the historical record nor modern measurements of little-disturbed forest on the coast and tablelands of south-eastern Australia.

Native plants have evolved in adaptation to particular soils, climates and disturbance patterns over millions of years. Our understanding of vegetation change from studies of pollen cores, combined with the results of research on the population dynamics of plant species in the Sydney sandstone region, suggest that the current shrub-dominated vegetation is not an artefact of post-European fire history. Since 1788 the structure and floristic composition of the vegetation has changed little in less disturbed sites, but in places affected by European land use including clearing, thinning, logging, changed fire regimes and weed invasion, change has occurred. Dense regrowth is occurring in some areas as a consequence of logging, clearing or flooding. Changed fire regime may contribute to this but it is only one factor. Left undisturbed this regrowth will self-thin over time.

The main causes of change to Australia's vegetation since European settlement have been large-scale clearing and cultivation of land (J. Benson 1991). Other factors include overgrazing of remnant vegetation by stock and feral animals; loss of native herbivores and vertebrate and invertebrate pollinators or seed dispersers; invasion of weed species in both agricultural and naturally vegetated areas; and changed fire regimes in some areas of forests, woodlands and grasslands. These factors have resulted in a reduction in native species diversity and biomass in the agricultural zones of the continent (with the exception of places with woody regrowth). Loss of top-soil over the last 200 years, combined with rising saline water tables, threaten the long term sustainability of agriculture over large tracts of land.

Finally, the impact of the early years of European settlement on the landscape of southern Australia is poignantly captured in the following recollection from E.M. Curr (1841–51 p. 82), about the changes to the forests near Moira on the Murray River:

Since that day, some five-and-thirty years only have passed, and the Blacks, reeds, and bell-birds are gone. Of the first scarce one remains; his cooey is heard no more in those parts, whilst the old forest itself is fast being converted by steam sawmills into railway sleepers. In our go-ahead days people of course are jubilant about such things, and I suppose I ought to be so too; but as a fact, the saws and the steam engines do not fill me with any particular delight, and I may as well out with the truth, that when the subject occurs to me it is to remember with regret the primitive scene, the Black with his fishing canoe, the silence, and the gum-trees.

The above passage was not selected by Ryan et al.

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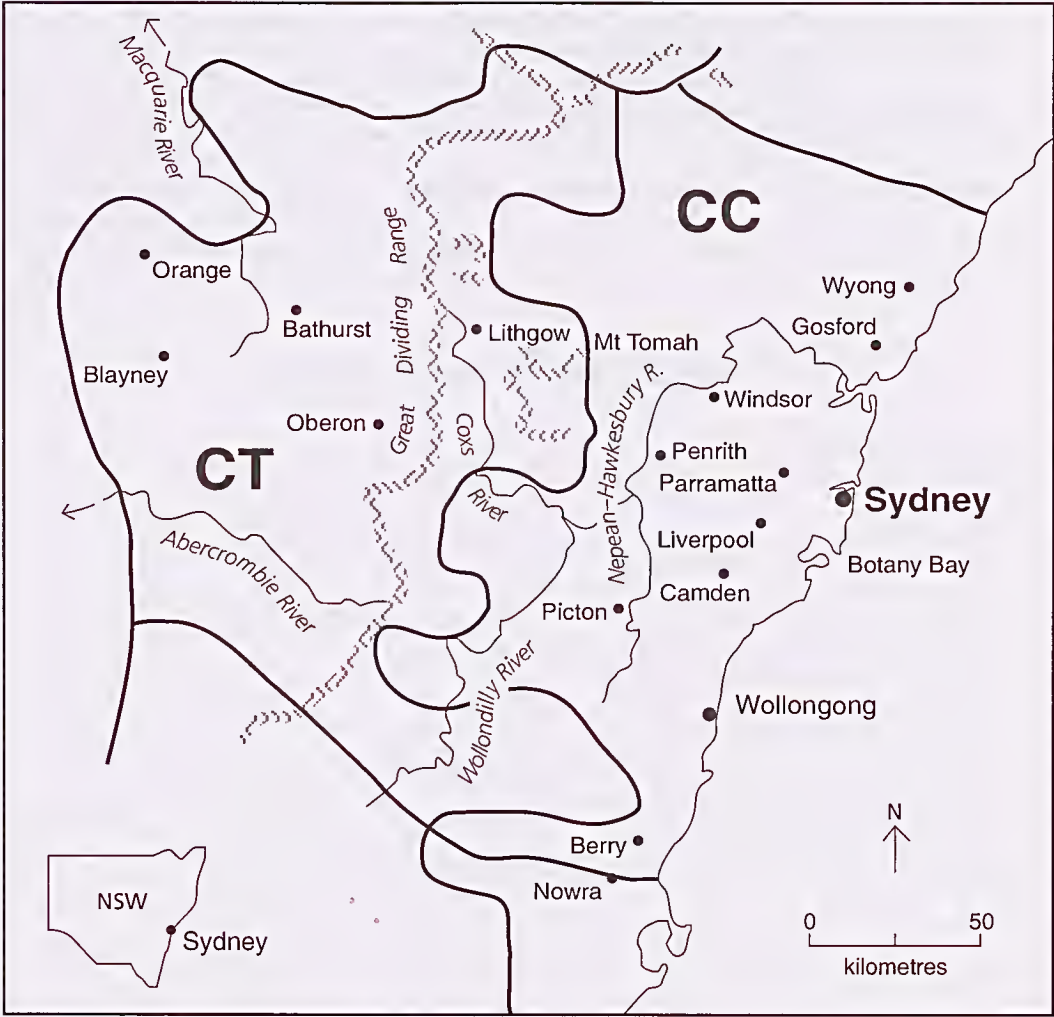
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Map of the Sydney region

For the Ecology of Sydney Plant Species the Sydney region is defined as the Central Coast and Central Tablelands botanical subdivisions.

Ecology of Sydney Plant Species

Part 5 Dicotyledon families Flacourtiaceae to Myrsinaceae

Doug Benson and Lyn McDougall

Abstract

Benson, Doug and McDougall, Lyn (National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, Australia 2000) 1997 Ecology of Sydney Plant Species: Part 5 Dicotyledon families Flacourtiaceae to Myrsinaceae. Cunninghamia 5(2) 330 to 544. Ecological data in tabular form are provided on 297 plant species of the families Flacourtiaceae to Myrsinaceae, 223 native and 74 exotics, mostly naturalised, occurring in the Sydney region, defined by the Central Coast and Central Tablelands botanical subdivisions of New South Wales (approximately bounded by Lake Macquarie, Orange, Crookwell and Nowra). Relevant Local Government Areas are Auburn, Ashfield, Bankstown, Bathurst, Baulkham Hills, Blacktown, Blayney, Blue Mountains, Botany, Burwood, Cabonne, Camden, Campbelltown, Canterbury, Cessnock, Concord, Crookwell, Drummoyne, Evans, Fairfield, Greater Lithgow, Gosford, Hawkesbury, Holroyd, Hornsby, Hunters Hill, Hurstville, Kiama, Kogarah, Ku-Ring-Gai, Lake Macquarie, Lane Cove, Leichhardt, Liverpool, Manly, Marrickville, Mosman, Mulwaree, North Sydney, Oberon, Orange, Parramatta, Penrith, Pittwater, Randwick, Rockdale, Ryde, Rylstone, Shellharbour, Shoalhaven, Singleton, South Sydney, Strathfield, Sutherland, Sydney City, Warringah, Waverley, Willoughby, Wingecarribee, Wollondilly, Wollongong, Woollahra and Wyong.

Data are derived from herbarium collections, literature and field observations. It is hoped that the many, often alarming gaps in the information available will stimulate much-needed research into the ecology of more of the species. Information is provided so far as available to us for each plant species in the following categories:

Life History: Growth form, vegetative spread, longevity, primary juvenile period (time from germination to fruiting), reproduction, flowering and fruiting times, fruit/seed type, dispersal, establishment and growth, fire response, interaction with other organisms.

Distribution: Status/origin (native/naturalised), botanical subregions, distribution in Sydney area, selected locations.

Habitat: Habitat, altitude, annual rainfall, typical local abundance, vegetation, substrate, exposure.

Conservation: Conservation status.

Introduction

The *Ecology of Sydney Plant Species* aims to provide ecological information on native and naturalised Sydney plants. Particular emphasis has been given to data that are relevant for ecologists and natural area managers, for people involved in bush regeneration, land rehabilitation and landscape design, for researchers in many fields and for a wide range of people who are interested in bushland and native plants. Species-specific information is also relevant to environmental impact assessment and to studies involving changes in drainage, water movement, wind exposure, nutrient conditions and fire regimes on plant species and plant communities. Information included covers growth form, flowering and fruiting times, longevity and maturation periods, pollination and seed dispersal data, distribution, habitat and plant community, as well as responses to fire and disturbance where available and is complementary to the descriptive texts in taxonomic handbooks such as the *Flora of New South Wales* (Harden 1990–93).

Part 5 of the *Ecology of Sydney Plant Species* covers the Dicotyledon families alphabetically from Flacourtiaceae to Myrsinaceae.

Methods

Part 5 follows the format used in Parts 1–4 (Benson & McDougall 1993, 1994, 1995, 1996). The Sydney region is defined as the Central Coast and Central Tablelands botanical subdivisions (i.e. approximately bounded by Lake Macquarie, Orange, Crookwell and Nowra) (Fig. 1). This is the area broadly covered by *Flora of the Sydney Region* (Carolin & Tindale 1993), with the exception that the Hunter Valley is not included here since it lies within the North Coast and Central Western Slopes subdivisions. Relevant Local Government Areas are Auburn, Ashfield, Bankstown, Bathurst, Baulkham Hills, Blacktown, Blayney, Blue Mountains, Botany, Burwood, Cabonne, Camden, Campbelltown, Canterbury, Cessnock, Concord, Crookwell, Drummoyne, Evans, Fairfield, Greater Lithgow, Gosford, Hawkesbury, Holroyd, Hornsby, Hunters Hill, Hurstville, Kiama, Kogarah, Ku-Ring-Gai, Lake Macquarie, Lane Cove, Leichhardt, Liverpool, Manly, Marrickville, Mosman, Mulwaree, North Sydney, Oberon, Orange, Parramatta, Penrith, Pittwater, Randwick, Rockdale, Ryde, Rylstone, Shellharbour, Shoalhaven, Singleton, South Sydney, Strathfield, Sutherland, Sydney City, Warringah, Waverley, Willoughby, Wingecarribee, Wollondilly, Wollongong, Woollahra and Wyong.

The Sydney region, as defined here, includes approximately 3500 plant species, both native and naturalised. To deal effectively with this number, the work has been divided into parts each of approximately 350 species based on plant families beginning with ferns, Cycads and Gymnosperms, and then Dicotyledon and Monocotyledon families. Within these groups, families, genera and species are arranged alphabetically:

- Part 1: Ferns, Fern allies, Cycads and Conifers,
Dicotyledon families Acanthaceae to Asclepiadaceae (*Cunninghamia* 3(2) 1993)
- Part 2: Dicotyledon families Asteraceae to Buddlejaceae (*Cunninghamia* 3(4) 1994)
- Part 3: Cabombaceae to Eupomatiaceae (*Cunninghamia* 4(2) 1995)
- Part 4: Fabaceae (*Cunninghamia* 4(4) 1996)
- Part 5: Flacourtiaceae to Myrsinaceae** (*Cunninghamia* 5(2) 1997)
- Part 6: Myrtaceae
- Part 7: Nyctaginaceae to Rubiaceae
- Part 8: Rutaceae to Zygophyllaceae
- Part 9: Monocotyledon families
- Part 10: Monocotyledon families

For each species (and generally for subspecies) a data sheet is prepared incorporating life history, distribution and habitat data from specimens in the National Herbarium of New South Wales; this information is entered in a database together with data from literature sources both published and unpublished. References have been cited where appropriate but for unreferenced data responsibility has been assumed by the authors. A provisional compilation sheet with the available information is then prepared and distributed to interested persons for comments and additions/alterations. This compilation is then published in parts in the summer issue of *Cunninghamia*, with the subsequent long-term aim of producing a book at the completion of the ten parts. This will allow the incorporation of new and additional material.

Part 6, Myrtaceae, is planned for publication in 1998, and any information that readers would like included should be sent to the authors by 30 June 1998.

Ecological review papers may be appropriate for families in future issues, particularly the major families e.g. Proteaceae and Myrtaceae, but papers would also be welcomed for smaller families. Authors interested in contributing such papers should contact the Scientific Editor.

Information categories

For each species or subspecies, information is presented under headings relating to different life-history aspects, each with further subdivisions. Emphasis has been given to understanding the species in its wild habitat. For this reason data on cultivation and artificial propagation, available in horticultural books, are generally not included. Likewise information on weed control is not given. Generally, the categories are broadly interpreted and since the project aims to stimulate further investigation, we welcome the addition of extra data on any other aspects of the plant's ecology.

Botanical nomenclature

Family/Genus/Species: Names currently recognised at the National Herbarium of NSW and mostly as used in *Flora of New South Wales*.

Common name: Names used in *Flora of New South Wales*.

Life history

Growth form: Brief description.

Source: *Flora of New South Wales*.

Vegetative spread: Indication of whether localised expansion or spread is possible from an individual by rhizome, stolon, rootsucker etc. Important in determining ability of species to colonise immediate local area. Does not include vegetative distance-dispersal which is included under Establishment & Growth (diaspore).

Source: Flora descriptions, Herbarium specimens, field observations.

Longevity: Average potential life-span under natural conditions — range in years where possible, indefinite, where death is not a result of inherent growth e.g. continued rhizomatous growth. Longevity may be shorter in cultivation.

Source: literature, authors' assessment from field observations.

Primary juvenile period: time taken from germination to produce first fruits or spores. Gill (1975) uses the term for the period from germination to flowering but the period to fruit maturity is more significant ecologically. Secondary juvenile period is time taken for individual to recover to produce fruit after major damage e.g. from fire, but applicable only if species regularly resprouts.

Source: literature, field observations.

Reproduction: for Angiosperms, reproduction is separated into:

Flowers: predominant flower colour, flowering period — range of months and, where possible, peak month based on frequency of herbarium collections. Pollination vectors.

Fruit: fruit shape and size, particularly with respect to potential dispersal agents. Maturation period. Seed size and number.

Source: Herbarium specimens, field observations, *Flora of New South Wales*, literature.

Establishment and growth: diaspore type (including vegetative), dispersal agent. Germination requirements: seedbank presence, dormancy, growth rates, seasonality, deciduousness etc. [notes on propagation in cultivation may be given where these imply similar behaviour under natural field conditions e.g. insights into seed germination inhibition].

Source: literature, field observations.

Fire response: general response of mature plant to fire, in particular whether it generally resprouts or is killed (see also Gill 1981, Gill & Bradstock 1992). Seedling recruitment associated with fire is included under establishment and growth.

Source: field observations, literature.

Interaction with other organisms: symbiosis, predators, diseases etc.

Source: mainly literature.

Distribution

Status/origin: native or naturalised, region of origin, source and date of introduction/naturalisation. Naturalised species indicated by an asterisk following the botanical name.

Source: *Flora of New South Wales*, literature.

Botanical subregions: occurrence of species in botanical subdivisions of NSW, other states and countries.

Source: National Herbarium of New South Wales.

Distribution in Sydney region: main geographic regions occupied by species.

Source: Herbarium specimen records.

Selected locations: restricted to about 10 localities for each taxon reflecting natural geographical range of species in the Sydney area. Earliest collection dates are given for some species, particularly exotic species. Recent collection sites indicated where possible. Locality data must be interpreted carefully. The record may be based on an old specimen or observation record and the species may no longer be present at the site. However a knowledge of the original distribution may be important in showing up particular habitat requirements of the species.

Source: Herbarium specimen records.

Habitat

Specific data refer to Sydney area unless stated otherwise.

Habitat: brief generalised description.

Source: Herbarium specimen records, field observations.

Altitude: approximate altitudinal range (m +/- 100 m) occupied by the species,

Source: Herbarium specimen records.

Annual rainfall: approximate annual rainfall range (mm +/- 100 mm) for sites occupied by the species.

Source: Bureau of Meteorology (1979).

Typical local abundance: most frequent recordings (scale: dominant/frequent/occasional/rare)

Source: Herbarium specimen records.

Vegetation: main structural type with typical associated species where available.

Source: Herbarium specimen records, field observations, literature.

Substrate: geology, soil, moisture supply.

Soil nutrient rating scale: very fertile (high nutrient) (e.g. basalt soils)/ fertile (moderate nutrient)/ infertile (low nutrient)/ very infertile (very low nutrient) (e.g. sands).

Soil water-table scale: permanently high/ mostly high/ mostly low/ permanently low.

Soil salinity scale: hypersaline/ saline/ brackish/ fresh.

Source: Herbarium specimen records, field observations, literature.

Exposure:

Exposure scale: exposed/ indifferent/ sheltered.

Shading scale: deep shade/ mid shade/ light shade/ no shade.

Source: Herbarium specimen records, field observations, literature.

Conservation

Conservation: national significance listing (Briggs & Leigh 1996), with current updating for Rare or Threatened Australian Plants (ROTAP) database maintained by NSW NPWS; inclusion on schedules of the NSW Threatened Species Conservation Act 1995; regional significance and adequacy of conservation within Sydney area where available.

Source: Herbarium records, field observations, literature.

General comments on part 5

Part 5 covers 297 plant species of the families Flacourtiaceae to Myrsinaceae, 223 native and 74 naturalised exotics. The occurrence of some native species reported to occur in the CC and CT botanical subdivisions in Harden (1990–1993) could not be confirmed from herbarium records and they have not been included here. Native plants excluded are *Amyema quandang* var. *quandang*, *Myoporum insulare*, *Neolitsea australiensis*, *Plectranthus graveolens*, *Pratia puberula*, and *Prostanthera nivea* var. *nivea*. *Prostanthera cineolifera* and *Prostanthera lanceolata* (following advice from B. Conn) have been included with *P. ovalifolia* sens. lat. *Prostanthera marifolia* is presumed extinct, possibly part of *P. densa* sens. lat. in the Sydney area (B. Conn pers. comm.). *Prostanthera saxicola* var. *bracteolata*, *Prostanthera saxicola* var. *montana*, and *Prostanthera saxicola* var. *saxicola* are included as *Prostanthera saxicola* (as suggested by B. Conn).

Also excluded from this work are a number of exotic species that do not appear to be truly naturalised: *Alcea rosea*, *Cotoneaster rotundifolius*, *Eriobotrya japonica*, *Gossypium hirsutum*, *Leonurus sibiricus*, *Malus X domestica*, *Malva sylvestris*, *Mentha X rotundifolia*, *Myriophyllum papillosum*, *Nepeta cataria*, *Plectranthus amboinicus*, *Plectranthus caninus* and *Plectranthus ornatus*, though there are some records for them growing in cultivation in the area.

In contrast to Part 4 which covered one family, the Fabaceae, Part 5 has 29 plant families. These include the characteristically Australian families where the majority of species are confined to Australia such as Goodeniaceae and Myoporaceae, and others such as Haloragaceae which has a main centre of diversity in Australia (Morley & Toelken 1983). More cosmopolitan families include Lamiaceae (previously Labiateae), Lauraceae, Geraniaceae, Lentibulariaceae and Malvaceae.

Like many of the small families covered in other parts of the *Ecology of Sydney Plant Species* there is very little information on their ecology and plenty of opportunity for research projects. Genera of the Goodeniaceae are important components of our sclerophyll communities and the lack of information about fire ecology, for example, is a major gap. Rainforest species such as those of Monimiaceae and Lauraceae

deserve work on seed dispersal and establishment, factors that are critical in maintaining forest remnants. Lamiaceae with a major centre of diversity in the Mediterranean and lesser one in Australia includes *Prostanthera* with 63 species. They occur widely in forest and woodland but we have virtually no information on aspects such as seed dispersal, establishment or fire ecology.

The interesting Bladderworts (*Utricularia*) in the specialised family Lentibulariaceae have sporadic distributional occurrences and would be worthwhile subjects of studies on longevity and recruitment. In the Mistletoes (Loranthaceae), another family with specialised growth forms, there is no research on dispersal and establishment despite the large number of hosts apparently parasitised. Ecological information about wetland plants such as Menyanthaceae is very minimal yet their habitats are vulnerable to disturbance.

Unlike the large Australia-centred families many of the small families included here have relatives outside Australia. Studies of these could benefit from overseas research but we should not extrapolate without due care. One example is *Gentiana wingecarribiensis*, a rare local endemic found at Wingecarribee Swamp in the Southern Highlands and endangered by changes to its habitat. While studies of the ecology of European gentian species suggest that a cold phase may be important in seed germination, specific studies of Australian Gentianaceae are needed to confirm if there are any similar patterns here. We should not assume similar strategies will apply from one species to another when dealing with ecological attributes. Australian species may behave quite differently to their overseas cousins.

With an increasing recognition of the importance of maintaining biological diversity it is important to recognize that we need not only to be able to identify species but to ensure their ongoing survival. To do this we must understand their ecology. The absence of ecological information on aspects such as fire ecology, dispersal and establishment is a major gap in our existing scientific knowledge base. Yet such studies could provide a wealth of projects for undergraduate and post-graduate studies, some of which are relatively straightforward, others more complicated. Doubtless even simple factors still remain undiscovered; for example the role of smoke in overcoming seed dormancy mechanism in some Western Australia species has only just been recognised. Obviously the first candidates for study are the rare and threatened species, but the ecology of the common species may be more important in the management of extensive bushland areas.

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Dicotyledon families Flacourtiaceae to Lobeliaceae

Dovyalis caffra *

FLACOURTIACEAE

Kei Apple

Life history

Growth form: Tree to 6 m high, with spines to 6 cm long; bark ashen-white to brown with longitudinal ridges and fissures.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Inconspicuous, male and female flowers on different plants.

Fruit/seed: Yellow berry, 2–4 cm diam., pulpy, juicy, edible, February–April.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to Africa.

Botanical subregions: NC CC.

Distribution Sydney area: Sporadic.

Select locations: CC: Seven Hills, Doonside, Wollongong (1912), Bomaderry, Nowra.

Habitat

Habitat:

Altitude: 0–100 m

Annual rainfall: 1000–1400 mm

Typical local abundance: Frequent.

Vegetation: Weedy, riparian vegetation e.g. with *Angophora floribunda*, *Acacia parramattensis*, *Melaleuca styphelioides*.

Substrate: Clay soil on alluvium, medium nutrients.

Exposure:

Conservation

Conservation: Occasionally naturalised, often persisting around old habitations (Harden 1990).

Scolopia braunii

FLACOURTIACEAE

Flintwood

Life history

Growth form: Shrub to medium-sized tree. Bark orange-brown, scaly (Floyd 1989).

Vegetative spread: Suckers, often forming extensive thickets, especially in coastal scrubs (A. Bofeldt & M. Robinson pers. comm.).

Longevity: Long-lived (M. Robinson pers. comm.).

Primary juvenile period:

Flowers: White or creamy, scented, October–November.

Fruit/seed: Berry, 12 mm diam. red turning black when ripe, with 2–4 angular seeds 3–5 mm long. 5825 fruit per kilogram, often infertile (Floyd 1989). Ripe November–March.

Dispersal, establishment & growth: Diaspore: fleshy fruit. Seed with no dormancy mechanism. Short viability, germination 2–6 weeks (A. Bofeldt pers. comm.).

Fire response: Coppicing (M. Robinson pers. comm.).

Interaction with other organisms: Food plant of Eastern Flat butterfly *Netrocoryne repandra repandra* (Common & Waterhouse 1982) and larvae of moth *Cerura australis* (Common 1990).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC ?CWS; Qld.

Distribution Sydney area: Coast and coastal ranges.

Select locations: CC: Gosford, Bouddi, Otford, Wollongong, Albion Park, Gerringong, Foxground, Minnamurra River.

	Habitat
Habitat: Bouldery hillsides, rocky creeks, estuarine riverbanks. Sea cliffs, escarpment slopes and gullies (M. Robinson pers. comm.).	
Altitude: 0–350 m	Annual rainfall: 1200–1600 mm
Typical local abundance: Occasional.	
Vegetation: Littoral rainforest e.g. with <i>Eucalyptus botryoides</i> , <i>Livistona australis</i> ; dry rainforest, sub-topical to warm temperate rainforest (M. Robinson pers. comm.).	
Substrate: Deep clay soils on sandstone, volcanics, medium to high nutrients. Quaternary alluvium, sand, Budgong Sandstone in Illawarra (M. Robinson pers. comm.).	
Exposure: Sheltered, or exposed to full sun and saltspray (M. Robinson pers. comm.).	
	Conservation
Conservation: Reported from Berkley Island NR, Budderoo NP, Macquarie Pass NP (A. Bofeldt & M. Robinson pers. comm.) but conservation status unknown.	

Fumaria bastardii *

FUMARIACEAE

Bastards Fumitory

	Life history
Growth form: Delicate scrambling herb 30–75 cm high, with weak trailing or climbing stems and deeply divided leaves. Plant with smoky odour (Bailey 1906).	
Vegetative spread: No.	
Longevity: Less than 1 year.	
Primary juvenile period: Less than 1 year.	
Flowers: Pink–whitish, at any time of year, peak September–October.	
Fruit/seed: Nut-like capsule, 2–3 mm diam.	
Dispersal, establishment & growth:	
Fire response:	
Interaction with other organisms:	
	Distribution
Status/origin: Exotic, native to Europe.	
Botanical subregions: NC CC SC CT ST NWS CWS SWS NWP SWP; LHI, Vic.	
Distribution Sydney area: Widespread.	
Select locations: CC: Berowra (1906), Manly, Peakhurst, Liverpool, Albion Park.	
CT: Kangaloon, Hill Top, Orange.	
	Habitat
Habitat: Creekbanks, roadsides, gardens.	
Altitude: 0–900 m	Annual rainfall: 900–1600 mm
Typical local abundance: Frequent.	
Vegetation: With roadside weeds e.g. <i>Holcus lanatus</i> *, <i>Bromus catharticus</i> *, <i>Sonchus oleraceus</i> .*	
Substrate: Clay soils on alluvium, shales and basalt, medium nutrients.	
Exposure: Mid-shade.	
	Conservation
Conservation: Widespread weed, not invasive of bushland.	

Fumaria capreolata subsp. *capreolata* *

FUMARIACEAE

Climbing Fumitory

Life history

Growth form: Delicate scrambling herb, sometimes climbing, with stems to 1 m long and deeply divided leaves. Plant with smoky odour (Bailey 1906).

Vegetative spread: No.

Longevity: Less than 1 year.

Primary juvenile period: 3 months.

Flowers: White or cream, turning pink after pollination, March–October.

Fruit/seed: Nut-like capsule, 2–3 mm diam.

Dispersal, establishment & growth:

Fire response: Probably killed by high intensity fire (1/94) at Lane Cove, seedlings flowering and fruiting within 3 months (P. Kubiak pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Exotic, native of Eurasia.

Botanical subregions: CC NWS SWS NWP SWP SFWP; Qld, S.A., W.A.

Distribution Sydney area: Sydney suburbs.

Select locations: CC: Beecroft (1948), Manly, Matraville, Campbelltown, Douglas Park.

Habitat

Habitat: Wasteland, creekbanks, gardens.

Altitude: 0–200 m **Annual rainfall:** 800–1400 mm

Typical local abundance: Frequent.

Vegetation: With garden weeds.

Substrate: Clay soil to deep sands, low–medium nutrients.

Exposure: Full sun.

Conservation

Conservation: Unlikely to invade bushland.

Fumaria muralis subsp. *muralis* *

FUMARIACEAE

Wall Fumitory

Life history

Growth form: Delicate scrambling herb, with deeply divided leaves.

Plant with smoky odour.

Vegetative spread:

Longevity: Less than 1 year.

Primary juvenile period: Less than 1 year.

Flowers: Pink-red, March–November.

Fruit/seed: Nut-like capsule, 2–3 mm diam.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to Europe.

Botanical subregions: NC CC SC CT ST NWS CWS SWS NWP SWP; Vic., Tas., S.A., W.A.

Distribution Sydney area: Widespread.

Select locations: CC: Dora Creek, Kurrajong, Lane Cove, La Perouse, Glenfield, Campbelltown (1963). CT: Kangaloon.

Habitat

Habitat: Roadside, wasteland, estuarine areas, pasture.

Altitude: 0–700 m **Annual rainfall:** 700–1400 mm

Typical local abundance: Frequent.

Vegetation: Estuarine swamp e.g. with *Casuarina glauca*.

Substrate: Clay soils on alluvium, shale, medium nutrients, some saline tolerance.

Exposure: Full sun.

Conservation

Conservation:

Fumaria officinalis* subsp. *officinalis* **FUMARIACEAE****Life history****Growth form:** Delicate scrambling herb, 15–50 cm high, with deeply divided leaves.

Plant with smoky odour.

Vegetative spread: No.**Longevity:** Less than 1 year.**Primary juvenile period:** 4 months.**Flowers:** Purple-pink, spring–summer.**Fruit/seed:** Nut-like capsule, 2–3 mm diam.**Dispersal, establishment & growth:** Diaspore: seeds, can survive in soil for up to 30 years; seed germinates in spring and early summer (Chancellor 1980).**Fire response:** Killed. Seedlings flowering and beginning to fruit within 4 months after high intensity fire (1/94) at Lane Cove (P. Kubiak pers. comm.).**Interaction with other organisms:** Foodplant of Stubble Quail *Coturnix pectoralis* (Barker & Vestjens 1989, 1990).**Distribution****Status/origin:** Exotic, native to Europe.**Botanical subregions:** CC SC CT ST CWS SWS NWP.**Distribution Sydney area:** Sporadic.**Select locations:** CC: Richmond (1920). CT: Bathurst (1963).**Habitat****Habitat:** Improved pasture. Waste places and gardens (Chancellor 1980).**Altitude:** 0–700 m**Annual rainfall:** 600 mm**Typical local abundance:****Vegetation:****Substrate:****Exposure:****Conservation****Conservation:** Weed in pasture, rarely collected.***Centaurium erythraea* *****GENTIANACEAE****Life history****Growth form:** Erect herb, usually 15–50 cm high, with basal rosette leaves as well as stem leaves.**Vegetative spread:** No (McIntyre et al. 1995).**Longevity:****Primary juvenile period:****Flowers:** Light red to dark pink, at any time of year, peak October–December.**Fruit/seed:** Capsule, 7–9 mm long, with numerous seeds.**Dispersal, establishment & growth:** Diaspore: mobile seed (McIntyre et al. 1995), possibly animal and water-dispersed (Carr et al. 1992).**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native of Europe.**Botanical subregions:** CC NT CT ST NWS CWS SWS; Vic., Tas., S.A.**Distribution Sydney area:** Widespread.**Select locations:** CC: Kariang, Pennant Hills, Kurnell, Hurstville (1886), Campbelltown, Springwood, Ilford, Kangaroo Valley. CT: Winburndale, Orange, Abercrombie Caves, Bowral.**Habitat****Habitat:** Pastures.**Altitude:** 0–1000 m**Annual rainfall:** 600–1400 mm**Typical local abundance:** Frequent.**Vegetation:** Grassland and pastures e.g. with *Cynodon dactylon**, *Paspalum dilatatum**, *Trifolium repens**, *Themeda australis*.**Substrate:** Clay and soils from shale, volcanics, sandy soil from sandstone, low to medium nutrients.**Exposure:** Full sun.**Conservation****Conservation:**

Centaurium spicatum

GENTIANACEAE

Spike Centaury

Life history

Growth form: Herb 25–40 cm high.**Vegetative spread:** No.**Longevity:** Usually less than one year, but sometimes 2 years.**Primary juvenile period:****Flowers:** Pink, November–March.**Fruit/seed:** Capsule, 7–10 mm long, with numerous seeds.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:** Naturalist George Bennett in 1860 wrote that colonists used it to treat dysentery and diarrhoea and as a tonic. Rev. Woolls in 1867 and 1887 told of its adoption by the medical profession. In 1898, botanist Joseph Maiden noted its use in WA and throughout NSW (Low 1990).

Distribution

Status/origin: Native.**Botanical subregions:** NC CC SC CWS NWP SWP NFWP SFWP; Qld, Vic., N.T., S.A., W.A., Eur.**Distribution Sydney area:** Coast and Cumberland Plain.**Select locations:** CC: Narrabeen, Parramatta, Casula, Moorebank, Agnes Banks, Wollongong, Kiama.

Habitat

Habitat:**Altitude:** 0–100 m**Annual rainfall:** 800–1400 mm**Typical local abundance:** Occasional.**Vegetation:** *Melaleuca* scrub e.g. with *Melaleuca decora*, *M. styphelioides*, *M. nodosa*, or woodland e.g. with *Eucalyptus moluccana*, *Casuarina glauca*, *Einadia nutans*.**Substrate:** Clay soils on shale, alluvium, poorly-drained, low to medium nutrients. Recorded on saline sites in western NSW (Semple 1993).**Exposure:**

Conservation

Conservation: Conservation status unknown.***Centaurium tenuiflorum* ***

GENTIANACEAE

Life history

Growth form: Erect herb 20–40 cm high.**Vegetative spread:** No (McIntyre et al. 1995).**Longevity:** Probably less than 1 year.**Primary juvenile period:** Less than 1 year.**Flowers:** Pink to reddish, August–May, peak November–January.**Fruit/seed:** Capsule 6–8 mm long, with numerous seeds, December–February.**Dispersal, establishment & growth:** Diaspore mobile (McIntyre et al. 1995).**Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native to Europe.**Botanical subregions:** NC CC SC NT CT ST NWS CWS NWP SWP NFWP; LHI, Qld, Vic., S.A., W.A.**Distribution Sydney area:** Widespread.**Select locations:** CC: Wyong, Cheltenham, Kurnell, Hurstville (1886), St Marys, Campbelltown, The Oaks, Albion Park, Kurrajong Heights. CT: Bathurst, Orange, Sofala.

	Habitat
Habitat: Pastures, grassland, roadsides.	
Altitude: 0–1000 m	Annual rainfall: 600–1400 mm
Typical local abundance: Frequent to occasional.	
Vegetation: <i>Melaleuca</i> scrub e.g. with <i>Melaleuca decora</i> , <i>Eucalyptus parramattensis</i> ; woodland e.g. with <i>Eucalyptus moluccana</i> , <i>Themeda australis</i> .	
Substrate: Clay soil from shale, alluvium, sandy soil on sandstone. Recorded on saline sites in western NSW (Semple 1993).	
Exposure:	
	Conservation
Conservation: Widespread minor weed of disturbed sites.	

Chionogentias cunninghamii* subsp. *cunninghamii
(*Gentianella diemensis* s. lat. complex)

GENTIANACEAE

	Life history
Growth form: Erect or ascending herb 25–55 cm high.	
Vegetative spread:	
Longevity:	
Primary juvenile period:	
Flowers: White with purplish to blue markings.	
Fruit/seed: Capsule 12–17 mm long,	
Dispersal, establishment & growth: Diaspore: seed.	
Fire response:	
Interaction with other organisms: New bee species <i>Lasioglossum</i> (<i>Parasphecodes</i>) <i>gentianae</i> collected on <i>Chionogentias cunninghamii</i> subsp. <i>cunninghamii</i> (Adams 1995). Larvae of moth <i>Stenoptilia zophodactylus</i> reported feeding on flowers (Common 1990).	
	Distribution

Status/origin: Native.	
Botanical subregions: CT ST; Vic., Tas.	
Distribution Sydney area: Boyd Plateau, Penrose.	
Select locations: CT: Belarah Swamp, Edith Swamp, Paddys River, Stingray Swamp Flora Reserve.	

	Habitat
Habitat: Frost-prone tableland swamps and creek margins amongst tall herbage and small shrubs (Adams 1995).	
Altitude: 1000–1200 m	Annual rainfall: 1100 mm
Typical local abundance: Frequent.	
Vegetation: Sedgeland with scattered shrubs e.g. <i>Empodisma minus</i> , <i>Restio australe</i> , <i>Carex</i> sp., <i>Baeckea utilis</i> . Wet Montane to subalpine tall heathland, often in open Snowgum–Black Sally woodland (Adams 1995).	
Substrate: Peaty swamps between shallow channels of water, permanently wet, low nutrients, sandy soils over granite.	
Exposure: Tolerant of frost and brief periods of winter snow (Adams 1995).	
	Conservation
Conservation: Rare, occurring in two disjunct areas; Boyd Plateau is northern geographical limit. Conservation status unknown.	

Cicendia filiformis *

GENTIANACEAE

Life history

Growth form: Herb 3–15 cm high.**Vegetative spread:** No.**Longevity:** Less than 1 year.**Primary juvenile period:** Less than 1 year.**Flowers:** Yellow, September–October.**Fruit/seed:** Capsule 3–4 mm long, with numerous seeds.**Dispersal, establishment & growth:** Diaspore: seed. Possibly animal and water-dispersed (Carr et al 1992).**Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native to Europe.**Botanical subregions:** CC; Vic., S.A.**Distribution Sydney area:** Coast of Sydney's Eastern Suburbs.**Select locations:** CC: Little Bay (1961), La Perouse.

Habitat

Habitat: Moist sites.**Altitude:** 0–50 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Rare.**Vegetation:** Heath**Substrate:** Shallow, damp, sandy soil on sandstone, low nutrients.**Exposure:**

Conservation

Conservation:*Cicendia quadrangularis* *

GENTIANACEAE

Life history

Growth form: Herb 3–8 cm high.**Vegetative spread:****Longevity:** Less than 1 year.**Primary juvenile period:** Less than 1 year.**Flowers:****Fruit/seed:** Capsule 3–5 mm long,**Dispersal, establishment & growth:** Possibly animal and water-dispersed (Carr et al 1992).**Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Exotic, native to N America.**Botanical subregions:** CC ST SWS; Vic., S.A.**Distribution Sydney area:** Sporadic.**Select locations:** CC: Duck River (1914), Tallong (1983).

Habitat

Habitat:**Altitude:** 0–600 m**Annual rainfall:** 700–1000 mm**Typical local abundance:****Vegetation:****Substrate:** Sandy soil on sandstone, shale.**Exposure:**

Conservation

Conservation:

Gentiana wingecarriensis

GENTIANACEAE

Life history

Growth form: Erect annual herb to 11 cm high, single-stemmed with single flower or up to 9-branched with terminal flowers (Kodala et al. 1994).

Vegetative spread: No.

Longevity: 3–4 months.

Primary juvenile period: Flowering from seed within 2–3 months (Kodala et al. 1994).

Flowers: Blue inside with greenish ribs on outside (Harden 1992). Flowering September–December to ?January. Corolla only known to open in bright sunlight (Kodala et al. 1994), pollen 1.75–2 micrometres in diam.

Fruit/seed: 2-valved capsule with many seeds, mature mainly November–December, seed size 0.25–0.35 mm (Kodala et al. 1994). Plants produce 1–2 capsules per plant, each containing roughly 300 seeds, but habitat quality may affect the number of capsules produced and longevity of plants in any one season (Robertson 1997).

Dispersal, establishment & growth: Diaspore: seed, probably dispersed by wind and water. Soil-stored seedbank with possible seed dormancy (Matthes et al. 1996). Possibly requires a cold phase for germination (Kodala et al. 1994), only small percentage of seed germinates, and only when environmental conditions are suitable (P. Kodala pers. comm.). Plants emerge August–October depending on season, large fluctuations in population size from year to year (Robertson 1997). Seed germination trials using temperature treatments and gibberellin so far unsuccessful (Errington & Offord 1997).

Fire response: Probably killed. Fires in spring are threat to population (Robertson 1997).

Interaction with other organisms: Compaction of soil by cattle making it difficult for plants to grow; slashing to reduce competition from shrubs and groundcovers may benefit plants (Robertson 1997).

Distribution

Status/origin: Native.

Botanical subregions: CT.

Distribution Sydney area: Robertson, Penrose.

Select locations: CT: Wingecarribee Swamp, Hanging Rock Swamp.

Habitat

Habitat: Ecotone area on swamp margin where sedgeland with some low shrubs intergrades with the surrounding grassland/pasture (Kodala et al. 1994), swamp margin and near spring mounds in Hanging Rock Swamp (P. Kodala pers. comm.).

Altitude: 650–700 m **Annual rainfall:** 1000–1600 mm

Typical local abundance: Frequent–occasional (Kodala et al. 1994).

Vegetation: Low open vegetation cover to 60 cm high of cropped grassland with *Poa labillardieri*, *Isachne globosa*, *Tetrarrhena turfosa* at Hanging Rock, *Baumea rubiginosa*, *Anthoxanthum odoratum*, *Centella cordifolia*, grasses and other herbs, sometimes on low *Sphagnum* hummocks at Wingecarribee (Kodala et al. 1994).

Substrate: Damp peat or peaty loam to clay loam; appears to be sensitive to altered water levels, watertable mostly high (Kodala et al. 1994). Extra water availability afforded by association with *Sphagnum* moss, which can absorb many times its own weight in water (Matthes et al. 1996).

Exposure: Full sun to partly shaded e.g. amongst *Themeda australis* and sedges or open canopy of *Leptospermum* shrubs (P. Kodala pers. comm.).

Conservation

Conservation: Local endemic listed under schedule 1, NSW Threatened Species Conservation Act 1995. Coded 2E (Briggs & Leigh 1996). Only known from Wingecarribee Swamp and Hanging Rock Swamp. Swamp threatened by drainage, cattle grazing and trampling, peat mining activities, inappropriate fire regimes and weeds at Wingecarribee (Kodala et al. 1994).

In danger of extinction in 10–20 years if present land use and threats continue (Robertson 1997). Situation at Hanging Rock not known. No successful ex situ germination or vegetative propagation has been achieved (Errington & Offord 1997), emphasizing the need for adequate conservation in the wild.

Sebaea ovata

GENTIANACEAE

Yellow Centaury

Life history**Growth form:** Erect herb 10–30 cm high, sometimes 50 cm high.**Vegetative spread:** No (McIntyre et al. 1995).**Longevity:** Less than 1 year.**Primary juvenile period:** Less than 1 year.**Flowers:** Yellow, September–December.**Fruit/seed:** Capsule 5 mm long, with numerous seeds.**Dispersal, establishment & growth:** Diaspore: seed, mobile (McIntyre et al. 1995).**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** CC SC NT CT ST NWS CWS SWS NWP; Vic., Tas., S.A., W.A.**Distribution Sydney area:****Select locations:** CC: Auburn, Homebush, Campbelltown, Megalong Valley. CT: Hill End, Wattle Flat, Wallerawang, Bowral.**Habitat****Habitat:****Altitude:** 0–800 m**Annual rainfall:** 600–900 mm**Typical local abundance:** Occasional.**Vegetation:** Open-forest e.g. with *Eucalyptus punctata*, *E. cypellocarpa*, *E. piperita*, *E. polyanthemos*, *E. macrorhyncha*.**Substrate:** Clay soils on shales, medium nutrients.**Exposure:****Conservation****Conservation:** Evidently widespread in the Auburn, Silverwater, Homebush Bay area in 1887 (Herb. specimen note) but now extinct there, and probably elsewhere in western Sydney. Conservation status elsewhere unknown.***Erodium botrys* ***

GERANIACEAE

Long Storksbill

Life history**Growth form:** Herb to 40 cm high, with hairy stems; leaves lobed and toothed.**Vegetative spread:****Longevity:** Less than 1 year.**Primary juvenile period:** Less than 1 year.**Flowers:** Blue, September–October.**Fruit/seed:** Capsule 9–12 cm long; separating into 5, 1-seeded, sharply-pointed units, September.**Dispersal, establishment & growth:** Diaspore: seed, animal-dispersed.**Fire response:****Interaction with other organisms:** Sharply-pointed seeds penetrate flesh of sheep (Harden 1992).**Distribution****Status/origin:** Exotic, native to Mediterranean region.**Botanical subregions:** NC CC ST SWS NWP; Qld, Vic., Tas., N.T., S.A., W.A.**Distribution Sydney area:** Flemington.**Select locations:** CC: Flemington Saleyards (1968).**Habitat****Habitat:****Altitude:** 0–100 m**Annual rainfall:** 900 mm**Typical local abundance:** Rare.**Vegetation:****Substrate:****Exposure:****Conservation****Conservation:** Only recorded for Flemington and now probably extinct there as a result of re-development of the site.

Erodium brachycarpum *

GERANIACEAE

Heronsbill

Life history

Growth form: Herb to 30 cm high, with hairy stems; leaves lobed and toothed.
Vegetative spread:
Longevity: Less than 1 year.
Primary juvenile period: Less than 1 year.
Flowers: Blue, August–October.
Fruit/seed: Capsule 6–9.5 cm long; separates into 5, 1-seeded, sharply-pointed units.
Dispersal, establishment & growth: Diaspore: seed, animal-dispersed.
Fire response:
Interaction with other organisms: Sharply-pointed seeds penetrate flesh of sheep (Harden 1992).

Distribution

Status/origin: Exotic, native to Africa.
Botanical subregions: CC ST CWS SW; Qld, Vic., Tas., N.T., S.A., W.A.
Distribution Sydney area: Flemington.
Select locations: CC: Flemington Saleyards (1968).

Habitat

Habitat:
Altitude: 0–100 m **Annual rainfall:** 900 mm
Typical local abundance:
Vegetation:
Substrate:
Exposure:

Conservation

Conservation: Only recorded for Flemington and now probably extinct there as a result of re-development.

Erodium cicutarium *

GERANIACEAE

Common Storksbill, Common Crowfoot

Life history

Growth form: Herb to 40 cm high, with hairy stems; leaflets hairy and toothed.
Vegetative spread:
Longevity: Less than 1 year.
Primary juvenile period: Less than 1 year.
Flowers: Blue, August–January.
Fruit/seed: Capsule 4–5 cm long; separates into 5, 1-seeded, hairy, sharply-pointed units.
Dispersal, establishment & growth: Diaspore: seed, animal-dispersed.
Fire response:
Interaction with other organisms: Sharply-pointed seeds penetrate flesh of sheep (Harden 1992).

Distribution

Status/origin: Exotic, native to Mediterranean region.
Botanical subregions: NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., N.T., S.A., W.A., native of Medit. region.
Distribution Sydney area: Widespread.
Select locations: CC: Cooks River (1909), Flemington, Richmond. CT: Bell, Hampton, Oberon, Sunny Corner, Bathurst, Junction Reefs, Berrima (1889).

Habitat

Habitat: Roadsides, soil dumps, pastures.
Altitude: 0–1000 m **Annual rainfall:** 600–1100 mm
Typical local abundance: Occasional.
Vegetation: Grassland e.g. formerly with *Eucalyptus blakelyi*–*E. bridgesiana*.
Substrate: Clay soils.
Exposure:

Conservation

Conservation:

Erodium crinitum

GERANIACEAE

Blue Storksbill, Blue Crowfoot

Life history

Growth form: Decumbent to ascending herb to 50 cm high, with hairy stems; leaves lobed and toothed.

Vegetative spread: No.

Longevity: Less than 1 year.

Primary juvenile period: Peak fruiting 10 weeks after germination (Cox & Conran 1996).

Flowers: Blue with white or yellow veins, August–October.

Fruit/seed: Capsule 4–5.6 cm long; separates into 5, 1-seeded, hairy, sharply-pointed units, October–December.

Dispersal, establishment & growth: Diaspore: seed, animal-dispersed. Dormancy maintained by hard, waterproof seed coat, and broken by scarification or fluctuating diurnal temperatures (Cox & Conran 1996).

Fire response:

Interaction with other organisms: Seed eaten by Galah *Cacatua roseicapilla* (Lepschi 1993). Sharply-pointed seeds penetrate flesh of sheep (Harden 1992).

Distribution

Status/origin: Native.

Botanical subregions: CC SC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., N.T., S.A., W.A.

Distribution Sydney area: Widespread.

Select locations: CC: Pennant Hills, Prospect, Marayong, Campbelltown, Kurrajong. CT: Sunny Corner, Joadja, Wombeyan Caves.

Habitat

Habitat:

Altitude: 0–800 m

Annual rainfall: 600–1100 mm

Typical local abundance: Occasional–rare.

Vegetation: Shrub thickets e.g. with *Bursaria spinosa*, *Rapanea variabilis*, *Pandorea pandorana*, and in open areas; or open-forest e.g. with *Eucalyptus moluccana* (M. Robinson pers. comm.).

Substrate: Clay soils on shale, medium nutrients, well-drained.

Exposure: Full sun.

Conservation

Conservation: Conservation status unknown.

***Erodium moschatum* ***

GERANIACEAE

Musky Crowfoot, Musky Storksbill

Life history

Growth form: Ascending herb to 40 cm high, with hairy stems and musk-like scent; pinnate leaves with toothed leaflets.

Vegetative spread:

Longevity: Less than 1 year.

Primary juvenile period: Less than 1 year.

Flowers: Pink, June–November.

Fruit/seed: Capsule 3–4.5 cm long; separates into 5, 1-seeded, hairy, sharply-pointed units.

Dispersal, establishment & growth: Diaspore: seed, animal-dispersed.

Fire response:

Interaction with other organisms: Foodplant of Stubble Quail *Coturnix pectoralis* (Barker & Vestjens 1989, 1990). Seed eaten by Galah *Cacatua roseicapilla* (Lepschi 1993). Sharply-pointed seeds penetrate flesh of sheep (Harden 1992).

Distribution

Status/origin: Exotic, native to Mediterranean. Reported by Robert Brown to be introduced to Sydney by 1804 (Maiden 1909).

Botanical subregions: NC CC SC CT ST NWS CWS SWS SWP; Vic., S.A.

Distribution Sydney area:

Select locations: CC: Beecroft, Flemington Saleyards. CT: Bathurst (1929), Orange.

		Habitat
Habitat:	Gardens, saleyards.	
Altitude:	0–1000 m	Annual rainfall: 600–1100 mm
Typical local abundance:		
Vegetation:		
Substrate:		
Exposure:		
		Conservation
Conservation:		

Geranium graniticola

GERANIACEAE

		Life history
Growth form:	Weakly decumbent, hairy herb with flowering stems to 50 cm long; leaves lobed and opposite, taproot thick.	
Vegetative spread:		
Longevity:	Perennial.	
Primary juvenile period:		
Flowers:	White, May, November.	
Fruit/seed:	Capsule 12–14 cm long, separates into 5, 1-seeded, hairy units; seeds black.	
Dispersal, establishment & growth:	Diaspore: probably seed.	
Fire response:		
Interaction with other organisms:		
		Distribution
Status/origin:	Native.	
Botanical subregions:	CT.	
Distribution Sydney area:	Kanangra-Boyd plateau to Oberon.	
Select locations:	CT: Oberon, Luthers Swamp, Jenolan Caves, Mt Blinda.	
		Habitat
Habitat:		
Altitude:	900–1200 m	Annual rainfall: 900–1200 mm
Typical local abundance:	Frequent.	
Vegetation:	Woodland e.g. with <i>Eucalyptus pauciflora</i> , <i>E. dalrympleana</i> with herbaceous understorey.	
Substrate:	Skeletal sandy loam on metasediments, low nutrients.	
Exposure:		
		Conservation
Conservation:	Local endemic, coded 3RC- on national rare species list (Briggs & Leigh 1996). Conservation status unknown.	

Geranium homeanum

GERANIACEAE

Life history

Growth form: Sprawling herb with flowering stems to 70 cm long, taproot fleshy, often much-branched.

Vegetative spread: No.

Longevity: Annual or short-lived perennial.

Primary juvenile period: 5 months.

Flowers: Pink-white, October–April.

Fruit/seed: Capsule 11–14 mm long, separates into 5, 1-seeded units; seeds brown, 2 mm long, mature October–April.

Dispersal, establishment & growth: Diaspore: seed, no special dispersal morphology (Westoby et al. 1990). Coloniser of disturbed areas.

Fire response: Resprouted from base after high intensity fire (1/94) at Lane Cove, seedlings flowering and beginning to fruit within 5 months (P. Kubiak pers. comm.).

Interaction with other organisms: Flowers visited for nectar by small dark native bees *?Homalictus* sp. (*?Halictidae*) probably pollinating flowers, also small grey butterfly (*Lycaenidae*) visiting flower, probably for nectar (P. Kubiak pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CT ST SWS; Qld, Vic.

Distribution Sydney area: Widespread.

Select locations: CC: Avoca, Denistone, Towra Point, Bilpin, Thirlmere Lakes, Jamberoo (M. Robinson p.c.). CT: Carrington Falls, Kowmung River, Mt Wilson, Nullo Mountain, Kanangra, Duckmaloi River. Robertson (Kodala 1990, 1995).

Habitat

Habitat: Moist forests, damper sites, creekbanks.

Altitude: 0–1200 m **Annual rainfall:** above 1000 mm

Typical local abundance: Occasional-frequent.

Vegetation: Warm temperate/cool temperate rainforest and tall eucalypt open-forest (P. Kodala pers. comm.); open-forest e.g. with *Syucarpia glomulifera*, *Angophora costata*; margins of rainforest and in light gaps; woodland e.g. with *Angophora floribunda*; grassland e.g. with *Themeda australis*.

Substrate: Moist clay loams from shales, basalt, limestone, and Devonian metasediments, medium nutrients, well-drained. Bumbo Latite and Budgong Sandstone in Illawarra (M. Robinson pers. comm.).

Exposure: Mid to light shade.

Conservation

Conservation: Probably adequate.

***Geranium molle* subsp. *molle* ***

GERANIACEAE

Cranesbill Geranium

Life history

Growth form: Biennial herb to 50 cm high, with softly hairy stems and thin taproot; leaves opposite and lobed.

Vegetative spread: No.

Longevity: 2 years.

Primary juvenile period: Less than 2 years.

Flowers: Mauvish-pink, September–October.

Fruit/seed: Capsule 8–11 mm long, separates into 5, 1-seeded units; seeds brownish, October–November.

Dispersal, establishment & growth: Diaspore: probably seed.

Fire response:

Interaction with other organisms: Foodplant of Stubble Quail *Coturnix pectoralis* (Barker & Vestjens 1989, 1990).

		Distribution
Status/origin: Exotic, native to Europe.		
Botanical subregions: NC CC SC NT CT ST NWS CWS SWS NWP; LHI, Qld, Vic., S.A.		
Distribution Sydney area:		
Select locations: CC: Cheltenham, La Perouse, Flemington Saleyards, Mt Kembla (1900), Albion Park, Jamberoo, Kangaroo Valley. CT: Wombeyan Caves (1965), Junction Reefs.		
		Habitat
Habitat: Disturbed sites.		
Altitude: 0–800 m	Annual rainfall: 600–1600 mm	
Typical local abundance: Frequent.		
Vegetation:		
Substrate: Clay soils.		
Exposure:		
		Conservation
Conservation: Weed of lawns, cultivated areas, waste places (Muenscher 1936).		

Geranium neglectum

GERANIACEAE

		Life history
Growth form: Decumbent herb with stems to 120 cm long; leaves opposite and lobed, taproot thick, short.		
Vegetative spread: Runners root at nodes.		
Longevity:		
Primary juvenile period:		
Flowers: Pink, November–March, peak March.		
Fruit/seed: Capsule 2 cm long, separates into 5, 1-seeded units; seeds dark brown.		
Dispersal, establishment & growth: Diaspore: seed.		
Fire response:		
Interaction with other organisms:		
		Distribution
Status/origin: Native.		
Botanical subregions: SC NT CT ST; Qld, Vic.		
Distribution Sydney area: Western Blue Mountains, Southern Highlands.		
Select locations: CT: Cudgegong River, Ben Bullen SF, Blackheath, Oberon, Edith, Boyd River, Mt Werong, Wingecarribee Swamp. Boyd Plateau swamps (Kodela et al. 1996).		
		Habitat
Habitat: Creekbanks and swamps.		
Altitude: 600–1000 m	Annual rainfall: 800–1400 mm	
Typical local abundance: Frequent to occasional.		
Vegetation: Sedge swamp e.g. with <i>Leptospermum obovatum</i> , <i>Lycopus australis</i> , <i>Phragmites australis</i> , <i>Isotoma fluviatilis</i> , <i>Lepidosperma longitudinale</i> . May be associated with trees <i>Eucalyptus pauciflora</i> or <i>E. camphora</i> .		
Substrate: Montane peatland, gravelly loam along creeks, over basalt, granite, sandstone, low nutrients, swampy sites.		
Exposure: Full sun to light shade.		
		Conservation
Conservation: Conservation status unknown.		

Geranium potentilloides var. *abditum*

GERANIACEAE

Life history

Growth form: Herb to 50 cm high, with softly hairy stems and thick taproot; leaves opposite and lobed.

Vegetative spread: No (McIntyre et al. 1995).

Longevity: Perennial.

Primary juvenile period:

Flowers: Pink, February–May.

Fruit/seed: Capsule 12–14 mm long, separates into 5, 1-seeded units with stiff hairs; seeds black.

Dispersal, establishment & growth: Diaspore: seed. No particular mechanism for dispersal (McIntyre et al. 1995).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NT CT ST; Vic.

Distribution Sydney area: Upper Blue Mountains.

Select locations: CT: Katoomba, Clarence, Zig Zag, Table Mountain, Mt Colong.

Habitat

Habitat: Hillsides.

Altitude: 900–1200 m

Annual rainfall: 1000–1400 mm

Typical local abundance: Frequent–occasional.

Vegetation: Moist forest e.g. with *Eucalyptus fastigata*, *E. blaxlandii*, *Lomandra longifolia*, *Stellaria pungens*; woodland e.g. with *Eucalyptus radiata*, *E. dalrympleana*.

Substrate: Sandy soil on sandstone, Devonian metasediments, basalt, low to high nutrients.

Exposure:

Conservation

Conservation:

Geranium potentilloides var. *potentilloides*

GERANIACEAE

Life history

Growth form: Herb to 50 cm high, with softly hairy stems and thick taproot; leaves opposite and lobed.

Vegetative spread:

Longevity: Perennial.

Primary juvenile period:

Flowers: Pink, September–May.

Fruit/seed: Capsule 12–14 mm long, separates into 5, 1-seeded units with stiff hairs; seeds brown, April.

Dispersal, establishment & growth: Diaspore: probably seed, possibly animal-dispersed.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC SC NT CT ST CWS; Vic., Tas., S.A., N.Z., N.G.

Distribution Sydney area: Upper Blue Mountains.

Select locations: CT: Mt Tomah, Mt Wilson, Bell, Ben Bullen, Hampton, Jenolan.

Habitat

Habitat: Creekbanks, swamps.

Altitude: 800–1000 m

Annual rainfall: 1000–1400 mm

Typical local abundance: Frequent.

Vegetation: Shrub swamp and moist open-forest e.g. with *Eucalyptus viminalis*, *E. radiata*, *E. dalrympleana*.

Substrate: Clay loam on creek banks and basalt, medium to high nutrients.

Exposure:

Conservation

Conservation:

Geranium retrorsum

GERANIACEAE

Common Cranesbill

Life history

Growth form: Ascending to decumbent herb with stems to 50 cm long, with softly hairy stems and turnip-shaped taproot; leaves opposite and lobed.

Vegetative spread:

Longevity: Perennial.

Primary juvenile period:

Flowers: Pink, January–April.

Fruit/seed: Capsule 10–17 mm long, separates into 5, 1-seeded, hairy units; seeds black to dark brown.

Dispersal, establishment & growth: Diaspore: probably seed.

Fire response:

Interaction with other organisms: Seed eaten by Crimson Rosella *Platycercus elegans* (Lepschi 1993).

Distribution

Status/origin: Native.

Botanical subregions: SC NT CT ST NWS CWS SWS NWP SWP; Vic., Tas., S.A., W.A., N.Z.

Distribution Sydney area: Bathurst–Orange.

Select locations: CT: Oberon, Sunny Corner, Bathurst, Evans Plains, Orange, Mittagong.

Habitat

Habitat: Roadsides, drains.

Altitude: 800–1200 m **Annual rainfall:** 600–1200 mm

Typical local abundance: Frequent.

Vegetation: Recorded with weedy species *Oenothera stricta**, *Verbena bonariensis**, and *Persicaria prostrata*.

Substrate: Alluvial soils. Recorded on saline sites in western NSW (Semple 1993).

Exposure:

Conservation

Conservation: Mostly old records with only one record since 1950. Possibly uncommon and inadequately conserved.

Geranium solanderi* var. *solanderi

GERANIACEAE

Life history

Growth form: Ascending to decumbent herb with stems to 50 cm long, with hairy stems and swollen, turnip-shaped taproot; leaves opposite and lobed. Two forms are sometimes recognised; there is considerable variation in flower size (Harden 1992).

Vegetative spread: No (McIntyre et al. 1995).

Longevity: Short.

Primary juvenile period:

Flowers: Pink, mainly March–December, peak October.

Fruit/seed: Capsule 12–15 mm long, separates into 5, 1-seeded units with stiff hairs; black seeds 2 mm long, September–December.

Dispersal, establishment & growth: Diaspore: seed. No particular mechanism for dispersal (McIntyre et al. 1995). Coloniser.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., Tas., S.A., W.A., NZ.

Distribution Sydney area: widespread

Select locations: CC: Putty, Richmond, Marayong, Manly, Nortons Basin, Campbelltown, Shellharbour, Kiama. CT: Hartley, Oberon, Mt Bindo, Hargraves, Junction Reefs.

Habitat

Habitat: Grasslands, woodlands. Open-forest in warm sunny locations (A. Bofeldt pers. comm.).

Altitude: 0–1200 m

Annual rainfall: 600–1200 mm

Typical local abundance: Frequent.

Vegetation: Grasslands and woodland e.g. with *Eucalyptus crebra*, *E. moluccana*, *E. pauciflora*, *E. dalrympleana*, *E. melliodora* with grassy understorey.

Substrate: Clay soils on Wianamatta Shale, Devonian metasediments, medium nutrients.

Exposure: High light requirements, intolerant of shade (A. Bofeldt pers. comm.).

Conservation

Conservation: Probably adequate.

Pelargonium australe

GERANIACEAE

Native Storksbill

Life history

Growth form: Herb to 50 cm high, with softly hairy stems and fleshy taproot; leaves opposite, lobed and toothed.

Vegetative spread:

Longevity: Perennial.

Primary juvenile period:

Flowers: Pink, October–March.

Fruit/seed: Capsule 8–15 mm long, separates into 5, 1-seeded, hairy units, October–March.

Dispersal, establishment & growth: Diaspore: 1-seeded unit.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CT ST NWS CWS SWS SFWP; LHI, Qld, Vic., Tas., S.A., W.A.

Distribution Sydney area: Coast and Bathurst/Orange.

Select locations: CC: Tuggerah, Maroubra, Botany Bay, Wollongong, Gerringong, Kiama, Glen Alice. CT: Kirkconnell, Junction Reefs, Orange, Mittagong.

Habitat

Habitat: Various e.g. rocky sites near dry rainforest (A. Bofeldt & M. Robinson pers. comm.), seacliffs.

Altitude: 0–1000 m **Annual rainfall:** 600–1400 mm

Typical local abundance: Occasional.

Vegetation: Sea cliff scrub and sand dune scrub on the coast; inland on cliffs, rocky outcrops.

Substrate: Dune sand on foredunes, cliff faces on metamorphic rocks, basalt, well drained. Bumbo Latite Member in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Full sun (A. Bofeldt & M. Robinson pers. comm.).

Conservation

Conservation: Conservation status unknown. Much of its dune habitat has been invaded by *Chrysanthemoides** species. Marked differences in coastal and inland habitats suggest that there may be genetic differences between populations, possibly different species. Needs research.

Pelargonium capitatum *

GERANIACEAE

Life history

Growth form: Shrubby herb to 1 m high, with softly hairy stems; leaves deeply lobed and toothed. Roots not tuberous.

Vegetative spread:

Longevity: Perennial.

Primary juvenile period:

Flowers: Pink, October.

Fruit/seed: Capsule 7 mm long, separates into 5, 1-seeded, hairy units, October.

Dispersal, establishment & growth: Diaspore: 1-seeded unit.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to S Africa.

Botanical subregions: CC; Vic., Tas., W.A.

Distribution Sydney area: Coast.

Select locations: CC: Bondi (1913), La Perouse, Lady Robinsons Beach (1913), Cape Solander, Kurnell (1907), Cronulla (1944).

Habitat

Habitat: Coastal dunes.

Altitude: 0–50 m **Annual rainfall:** 1200–1400 mm

Typical local abundance: Occasional.

Vegetation: Sand dune scrub, occasionally seacliff scrub.

Substrate: Sand, and sand over sandstone, well-drained, low nutrients.

Exposure:

Conservation

Conservation:

Pelargonium fragrans *

GERANIACEAE

Nutmeg Geranium

Life history

Growth form: Compact, hairy subshrub to 50 cm high, with toothed, lobed leaves.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** White, summer.**Fruit/seed:** Fruit not seen.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Exotic, native to Africa.**Botanical subregions:** CC.**Distribution Sydney area:****Select locations:** CC: Warrimoo (1955).

Habitat

Habitat:**Altitude:** 500 m**Annual rainfall:** 1200 mm**Typical local abundance:****Vegetation:****Substrate:****Exposure:**

Conservation

Conservation: Cultivated, rarely if ever naturalised in Sydney district.*Pelargonium inodorum*

GERANIACEAE

Life history

Growth form: Herb to 35 cm high, with softly hairy stems; leaves opposite and toothed; taproot fleshy.**Vegetative spread:****Longevity:****Primary juvenile period:** Less than 1 year.**Flowers:** Deep pink.**Fruit/seed:** Capsule 10–14 mm long, separates into 5, 1-seeded, hairy units.**Dispersal, establishment & growth:** Diaspore: 1-seeded unit.**Fire response:** Reported from remains of old campfire, suggesting that it colonised ashbeds. Seedlings commonly flowering and fruiting in less than 1 year after high intensity fire (1/94) at Lane Cove and Narrabeen (P. Kubiak pers. comm.).**Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWP; Qld, Vic., Tas., N.Z.**Distribution Sydney area:** Widespread.**Select locations:** CC: Kogarah, Parramatta, Liverpool, Kurrajong Heights, Nortons Basin, Otford, Thirlmere. CT: Mt Wilson, Wolgan Gap, Jenolan Caves.

Habitat

Habitat: Among rocks, sometimes near the sea.**Altitude:** 0–1000 m**Annual rainfall:** 800–1200 mm**Typical local abundance:** Rare.**Vegetation:** Burnt *Imperata cylindrica* grassland.**Substrate:** Clay soils on shale, limestone.**Exposure:**

Conservation

Conservation: Mostly old collections, including a high proportion from pre-1900 suggesting the species may have been relatively more common then. Vulnerable in Western Sydney (Benson & McDougall 1991).

Pelargonium rodneyanum

GERANIACEAE

Life history

Growth form: Perennial herb to 40 cm high, with softly hairy stems; leaves mostly basal, opposite and lobed; roots bear tubers sometimes in chains.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Deep pink, November–May.

Fruit/seed: Dry fruit 18–22 mm long, separates into 5, 1-seeded, hairy segments.

Dispersal, establishment & growth: Diaspore: 1-seeded segment.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CT ST; Vic., S.A.

Distribution Sydney area: Tallong.

Select locations: CT: Barbers Creek (1897).

Habitat

Habitat: Exposed rocky slopes.

Altitude: 800 m **Annual rainfall:** 700 mm

Typical local abundance: Eucalypt woodland.

Vegetation:

Substrate:

Exposure:

Conservation

Conservation: Restricted occurrence in NSW to Shoalhaven River to Bungonia

Lookout. No recent collections, conservation status unknown.

Pelargonium × *asperum* *

GERANIACEAE

Rose Geranium

Life history

Growth form: Hairy shrub to 1 m high, with an aromatic odour and fleshy taproot.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Pink, September–January.

Fruit/seed: Capsule 15–20 mm long, separates into 5, 1-seeded, hairy units.

Dispersal, establishment & growth: Diaspore: 1-seeded unit.

Fire response:

Interaction with other organisms: Cultivated as an ornamental and for aromatic oil (Harden 1992).

Distribution

Status/origin: Exotic, native to Mediterranean region. Introduced as ornamental and for its aromatic oil.

Botanical subregions: CC SC; Vic., S.A.

Distribution Sydney area: Coast.

Select locations: CC: Northbridge (1953).

Habitat

Habitat:

Altitude: 0–50 m **Annual rainfall:** 1200–1400 mm

Typical local abundance:

Vegetation:

Substrate:

Exposure:

Conservation

Conservation: Widely cultivated, occasionally naturalised in coastal districts.

***Pelargonium* × *domesticum* ***

GERANIACEAE

Pelargonium

Life history

Growth form: Diffuse softly hairy shrub to 1 m high. Apparently derived from several S African species.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Pink, September–January.

Fruit/seed: Capsule 8–15 mm long, separates into 5, 1-seeded, hairy units; seed often not set.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to S Africa, introduced as ornamental.

Botanical subregions: CC; Tas., S.A.

Distribution Sydney area: La Perouse.

Select locations: CC: La Perouse (1975).

Habitat

Habitat: Near coast.

Altitude: 0–50 m

Annual rainfall: 1300 mm

Typical local abundance: Frequent.

Vegetation: Probably in heath or woodland.

Substrate: Sandy soil.

Exposure:

Conservation

Conservation: Widely cultivated, occasionally naturalised in the Sydney district.

Fieldia australis

GESNERIACEAE

Life history

Growth form: Climber with opposite leaves and adventitious roots, epiphytic/lithophytic.

Vegetative spread: Layers easily and spreads readily (A. Bofeldt pers. comm.).

Longevity:

Primary juvenile period:

Flowers: Creamy white, September–May, peak April.

Fruit/seed: Succulent berry whitish flecked with purple, 10–30 mm long, October–December.

Dispersal, establishment & growth:

Fire response: Likely to be killed (A. Bofeldt pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST; Qld, Vic.

Distribution Sydney area: Coast and upper Blue Mountains, Southern Highlands.

Select locations: CC: Watagan Mountain, Barren Grounds, Upper Kangaroo Valley, Bomaderry. CT: Mt Tomah, Mt Wilson, Robertson, Fitzroy Falls.

Habitat

Habitat: Wet rocks, creek banks. Cool moist sites.

Altitude: 200–1000 m

Annual rainfall: 1400–1800 mm

Typical local abundance: Frequent.

Vegetation: Cool temperate rainforest e.g. with *Doryphora sassafras*, *Ceratopetalum apetalum*, *Hedycarya angustifolia*; warm temperate rainforest with *Acmeua smithii*, *Backhousia myrtifolia*, *Dicksonia antarctica*, *Cyathea australis*; subtropical rainforest (A. Bofeldt pers. comm.).

Substrate: Epiphytic on trees and treefern trunks, lithophytic on sandstone. On moist clay banks and slopes, intolerant of dry conditions (A. Bofeldt pers. comm.).

Exposure: Full shade.

Conservation

Conservation: Probably adequately conserved.

Brunonia australis**GOODENIACEAE**

Blue Pincushion

Life history**Growth form:** Herb with a short hairy stem; leaves in a basal cluster (in Sydney region).**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Blue, December–January.**Fruit/seed:** 1-seeded nut 3 mm long, in persistent calyx.**Dispersal, establishment & growth:** Diaspore: fruit (with calyx). Probably wind-dispersed (R. Carolin pers. comm.), seed probably has dormancy mechanism.**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** CT ST CWS SWS NWP SWP NFWP; N.T., Qld, S.A., Tas., Vic., W.A.**Distribution Sydney area:** Upper Blue Mountains**Select locations:** CT: Katoomba, Blackheath, Bell, Newnes Plateau.**Habitat****Habitat:** Open sites.**Altitude:** 1000–1200 m **Annual rainfall:** 1100–1400 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Open sites in open-forest e.g. with *Eucalyptus sieberi*, *E. sclerophylla*, *Poa* sp., *Grevillea laurifolia*, *Pimelea linifolia*, *Brachyloma daphnoides*.**Substrate:** Low nutrient sandy soil on sandstone, well-drained.**Exposure:** Full sun to light shade.**Conservation****Conservation:** Probably adequately conserved as most populations in the region appear to be in National Parks (R. Carolin pers. comm.).***Cooperookia barbata*****GOODENIACEAE****Life history****Growth form:** Erect, hairy subshrub to 1 m high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Blue to mauve, August–April, peak November–December.**Fruit/seed:** Capsule 5–7 mm long, with glossy seeds, mature August–April. Seed with aril (R. Carolin pers. comm.).**Dispersal, establishment & growth:** Diaspore: seed, probably ant-dispersed (R. Carolin p.c.).**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** CC SC NT CT ST NWS CWS; Vic., Tas.**Distribution Sydney area:** Widespread.**Select locations:** CC: Putty, Campbelltown, Otford, Cataract River, Thirlmere Lakes.**CT:** Yerranderie, Mt Wilson, Glen Davis, Rylstone, Jenolan Caves, Robertson, Bundanoon.**Habitat****Habitat:** Open-forest.**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Eucalypt open-forest e.g. with *Corymbia gummifera*, *Eucalyptus sieberi*, *E. punctata*, *E. piperita*, and woodland e.g. with *Corymbia eximia*, *C. gummifera*, *Angophora euryphylla*, with shrubby understorey e.g. *Grevillea buxifolia*, *Dampiera stricta*, *Allocasuarina littoralis*, *Podolobium ilicifolium*, *Acacia linifolia*.**Substrate:** Sandy loam on sandstone, conglomerate, low nutrients.**Exposure:****Conservation****Conservation:** Probably adequately conserved (R. Carolin pers. comm.).

Dampiera purpurea

GOODENIACEAE

Life history**Growth form:** Small, erect shrub with angular woolly branches.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Blue with dark grey hairs, September–December. Sometimes white or pink (R. Carolin pers. comm.).**Fruit/seed:** Nut 4–5 mm long, with one seed, December–March.**Dispersal, establishment & growth:** Diaspore: nut often with anthers and style attached (R. Carolin pers. comm.).**Fire response:** Stems killed, resprouts from base. Resprouting plants flowered in 10 months, reaching peak 2–3 years after high intensity fire (1/94) at Lane Cove, seedlings seen within 8 weeks of the fire (P. Kubiak pers. comm.).**Interaction with other organisms:** Some plants heavily cropped by rabbits; flowers visited by honey bees (*Apis mellifera*) and butterflies (Hesperiidae, Lycaenidae) to feed on nectar, probably pollinating flowers (P. Kubiak pers. comm.).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS; Vic., Qld.**Distribution Sydney area:** Widespread south of Broken Bay.**Select locations:** CC: Berowra, Hornsby, Lane Cove, Lower Portland, Springwood, Wallacia Wedderburn, Cordeaux Dam. CT: Blackheath, Jenolan River, Winburndale, Hilltop, Robertson, Mittagong.**Habitat****Habitat:** Open-forest.**Altitude:** 0–1200 m**Annual rainfall:** 800–1600 mm**Typical local abundance:** Frequent to occasional.**Vegetation:** Eucalypt open-forest e.g. with *Angophora costata*, *Eucalyptus pilularis*, *Corymbia eximia*, *C. gummifera*, *E. sieberi*, *E. piperita*, *E. cypellocarpa*.**Substrate:** Sandy soil on sandstone, also on clay soils, low to medium nutrients, well-drained.**Exposure:****Conservation****Conservation:** Widespread and probably adequately conserved.***Dampiera scottiana***

GOODENIACEAE

Life history**Growth form:** Small, erect, multistemmed subshrub to 60 cm high; stems covered with grey hairs.**Vegetative spread:** Root suckers.**Longevity:****Primary juvenile period:****Flowers:** Deep blue-violet, with silvery-grey hairs, August–November.**Fruit/seed:** 1-seeded nut 3–4 mm long, with silvery-grey hairs.**Dispersal, establishment & growth:** Diaspore: nut often with anthers and style attached (R. Carolin pers. comm.).**Fire response:** Resprouts from base.**Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** CC SC.**Distribution Sydney area:** Marra Marra NP.**Select locations:** CC: Smugglers Ridge (Marra Marra NP), Port Jackson (1881).

Habitat**Habitat:** Ridge.**Altitude:** 0–200 m**Annual rainfall:** 900 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Low open woodland e.g. with *Eucalyptus haemastoma*, *Angophora hispida*, *Banksia spinulosa*, *Darwinia biflora*, *Mirbelia speciosa*, *Dampiera stricta*.**Substrate:** Shallow, sandy soil over yellow clay, low nutrients.**Exposure:** Full sun.**Conservation****Conservation:** Localised population in Marra Marra NP, disjunct from main South Coast population in Nowra–Kangaroo River area. Conservation status unknown.***Dampiera stricta*****GOODENIACEAE****Life history****Growth form:** Small, erect shrub, often almost herbaceous; stem with 3 acute angles.**Vegetative spread:** Not capable of root suckering.**Longevity:** Indefinite (D. Keith pers. comm.).**Primary juvenile period:****Flowers:** Blue (dark purple form at La Perouse). June–December, peak October.**Fruit/seed:** Small nut, with one seed; seeds difficult to find, November–February.**Dispersal, establishment & growth:** Diaspore: seed, with a flaky coating (J. Howell pers. comm.), adapted for ant-dispersal (Westoby et al. 1990)**Fire response:** Stems killed and resprouts from base rapidly, even in absence of rain. Secondary juvenile period 1 year (D. Keith pers. comm.). Seedlings seen about 5 months after high intensity fire (1/94) at Narrabeen, with peak flowering 2–3 years after the fire (P. Kubiak pers. comm.).**Interaction with other organisms:** Commonly eaten by rabbits; flowers visited by hoverfly (Syrphidae), and native bee probably feeding on nectar and pollinating flowers (P. Kubiak pers. comm.).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT ST; Qld, Vic., Tas.**Distribution Sydney area:** Widespread.**Select locations:** CC: Kincumber, Woy Woy, Hornsby, Frenchs Forest, Bondi, Oatley, Coogee, Stanwell Park, Bomaderry, Springwood. CT: Mt Coricudgy, Wentworth Falls, Newnes Plateau, Mittagong.**Habitat****Habitat:** Heath and open-forest on sandstone.**Altitude:** 0–1200 m**Annual rainfall:** 900–1400 mm**Typical local abundance:** Frequent.**Vegetation:** Heath e.g. with *Angophora hispida*, *Allocasuarina distyla*, *Banksia ericifolia*, mallee e.g. with *Eucalyptus stricta*; woodland e.g. with *Eucalyptus piperita*, *Angophora costata*, *Corymbia gummifera*, *Eucalyptus haemastoma*.**Substrate:** Sandy soil on sandstone, low nutrients.**Exposure:****Conservation****Conservation:** A widespread species that is probably adequately conserved.

Goodenia bellidifolia* subsp. *bellidifolia**GOODENIACEAE****Life history**

Growth form: Perennial herb with persistent basal rosette of leaves.

Vegetative spread: No (McIntyre et al. 1995).

Longevity: 25–60 years (D. Keith pers. comm.).

Primary juvenile period: 4 years (Benson 1985).

Flowers: Orange to yellow, with yellow hairs, August–April, peak November–December. Insect-pollinated (Haviland 1885).

Fruit/seed: Capsule 4 mm long, with brown seeds 1 mm diam, October–April.

Dispersal, establishment & growth: Diaspore: seed with food body adapted for ant-dispersal (Westoby et al. 1990), the mucilaginous rim or wing thought by Westoby et al. to be an adaptation to ant-dispersal may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).

Fire response: Stems killed, resprouts from base, though survival may depend on fire intensity. Secondary juvenile period 2 years (D. Keith pers. comm., P. Kubiak pers. comm.).

Interaction with other organisms: One plant possibly eaten by rabbits; flowers visited by small black ?native bees (?Euryglossinae, ?Colletidae, *Exoneura* sp. Anthophoridae), black ant and a fly, possibly pollinated by native bees (P. Kubiak pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST CWS; Vic.

Distribution Sydney area: Widespread.

Select locations: CC: Doyalson, Hornsby, Belrose, Manly, Rookwood, Sutherland, Cambewarra. CT: Hilltop, Mittagong, Bilpin, Katoomba, Lithgow, Glen Davis, Orange, Wingello.

Habitat

Habitat: Almost anywhere in slightly damp sandy soils (R. Carolin pers. comm.).

Altitude: 0–1200 m **Annual rainfall:** 700–1400 mm

Typical local abundance: Frequent–occasional.

Vegetation: Open-forest e.g. *Eucalyptus piperita*, *Angophora costata*; woodland e.g. with *Corymbia gummiifera*; near sedgeland and swamps.

Substrate: Shallow, sandy soil over sandstone, low nutrients.

Exposure: Light to mid shade.

Conservation

Conservation: A widespread species, probably adequately conserved.

Goodenia decurrens**GOODENIACEAE****Life history**

Growth form: Erect subshrub to 80 cm high.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Yellow, August–March, peak December–January. Insect-pollinated (Haviland 1885).

Fruit/seed: Capsule, 9 mm long with pale brown seeds 1.8 mm long, November–January.

Dispersal, establishment & growth: Diaspore: seed with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC CT CWS.

Distribution Sydney area: Blue Mountains.

Select locations: CC: Culoul Range, Upper Colo, Kurrajong Heights. CT: Mt Tomah, Woodford, Wentworth Falls, Blackheath, Clarence, Rylstone.

	Habitat
Habitat: On cliffs or amongst boulders.	
Altitude: 600–1200 m	Annual rainfall: 800–1400 mm
Typical local abundance: Occasional to frequent.	
Vegetation: Open-forest with shrub understorey, or with <i>Gleichenia</i> .	
Substrate: Sandstone, cliff faces and moist gullies, low nutrients.	
Exposure: Sheltered.	
	Conservation
Conservation: Probably adequately conserved.	

<i>Goodenia dimorpha</i> var. <i>angustifolia</i>	GOODENIACEAE
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	Life history
Growth form: Erect herb to 50 cm high with adventitious roots.	
Vegetative spread:	
Longevity:	
Primary juvenile period: Primary juvenile period 2–? (>6?) years (D. Keith pers. comm.).	
Flowers: Yellow, December–September. Insect-pollinated (Haviland 1885).	
Fruit/seed: Capsule 8–10 mm long, with dark brown seeds 1.5 mm long.	
Dispersal, establishment & growth: Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).	
Fire response:	
Interaction with other organisms:	
	Distribution
Status/origin: Native.	
Botanical subregions: CC.	
Distribution Sydney area: Coast, Gosford–Waterfall.	
Select locations: CC: Somersby, Woy Woy, Wondabyne, Woronora River, Loftus, Garie Beach, Waterfall.	
	Habitat
Habitat: Swampy heath.	
Altitude: 0–200 m	Annual rainfall: above 1200 mm
Typical local abundance: Frequent.	
Vegetation: Wet heath or any landform and any aspect (R. Carolin pers. comm.).	
Substrate: Damp silty sand over sandstone, very infertile. Watertable usually high, moisture intermittent, fresh.	
Exposure:	
	Conservation
Conservation: Local endemic but probably adequately conserved.	

Goodenia dimorpha* var. *dimorpha

GOODENIACEAE

Life history**Growth form:** Erect herb to 50 cm high with adventitious roots.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Yellow, January–April, peak March. Insect-pollinated (Haviland 1885).**Fruit/seed:** Capsule 8–10 mm long, with dark brown seeds 1.5 mm long.**Dispersal, establishment & growth:** Diaspore: seed, adapted for ant-dispersal (Rice & Westoby 1981), though the mucilaginous rim or wing thought by Westoby et al. to be an adaptation to ant-dispersal may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.). Recruitment mainly after fire (D. Keith pers. comm.).**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).**Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** CC CT.**Distribution Sydney area:** Mainly Upper Blue Mountains.**Select locations:** CC: Cowan, Woodford, Wentworth Falls. CT: Katoomba, Blackheath.**Habitat****Habitat:** Growing in unstable boggy soil and areas subject to strong winds (Maiden & Betche 1903).**Altitude:** 0–1000 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Occasional.**Vegetation:** Ground stratum in tall moist shrubland e.g. with *Epacris obtusifolia*, *Leptospermum polygalifolium*.**Substrate:** Peaty soil over sandstone, very infertile. Watertable permanently high, moisture continuous, fresh.**Exposure:** Full sun.**Conservation****Conservation:** Local endemic, probably adequately conserved.***Goodenia glomerata***

GOODENIACEAE

Life history**Growth form:** Erect herb to 50 cm high, with woody base, yellowish to grey and hairy when young.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Yellow, August–January. Insect-pollinated (Haviland 1885).**Fruit/seed:** Cylindrical capsule 8–9 mm long, with brown seeds 1.5 mm long.**Dispersal, establishment & growth:** Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** SC CT ST.**Distribution Sydney area:** Bundanoon.**Select locations:** CT: Bundanoon (1947) only record for Sydney area.

Habitat	
Habitat: Rocky places in cracks, seepages.	
Altitude: 600 m	Annual rainfall: 1100 mm
Typical local abundance:	
Vegetation: Heath e.g. with <i>Banksia ericifolia</i> , <i>Allocasuarina distyla</i> .	
Substrate: Shallow, sandy soils on sandstones and conglomerates, boggy areas or on rocks, low nutrients.	
Exposure: Full sun.	
Conservation	
Conservation: Coded 2RCa on national rare species list (Briggs & Leigh 1996). Mainly a south coast species in Budawang NP and Morton NP, Bundanoon is northern geographical limit.	

Goodenia grandiflora

GOODENIACEAE

Life history	
Growth form: Erect, sticky shrub to 1.5 m high.	
Vegetative spread:	
Longevity:	
Primary juvenile period:	
Flowers: Yellow, July–November. Insect-pollinated (Haviland 1885).	
Fruit/seed: Capsule, 10–13 mm long, seeds 3 mm long.	
Dispersal, establishment & growth: Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).	
Fire response:	
Interaction with other organisms:	
Distribution	
Status/origin: Native.	
Botanical subregions: NC CT NWS CWS; Qld, N.T.	
Distribution Sydney area: Western Blue Mountains.	
Select locations: CT: Jenolan River Crossing, Wombeyan Caves.	

Habitat	
Habitat: Rocky sites.	
Altitude: 600–800 m	Annual rainfall: 600–1000 mm
Typical local abundance: Rare.	
Vegetation: Woodland e.g. with <i>Eucalyptus tereticornis</i> , <i>E. melliodora</i> .	
Substrate: Clay loam on quartzite, sandstone, siltstone, claystone and igneous rocks, low to medium nutrients.	
Exposure:	
Conservation	
Conservation: Rare with few collections, conservation status unknown. Scattered, uncommon (R. Carolin pers. comm.).	

Goodenia hederacea* subsp. *hederacea**GOODENIACEAE****Life history**

Growth form: Prostrate to ascending herb, to 80 cm high.

Vegetative spread: Yes (McIntyre et al. 1995).

Longevity:

Primary juvenile period:

Flowers: Yellow, September–April, peak October. Insect-pollinated (Haviland 1885).

Flowers visited by small black ?native bees (?Euryglossinae, ?Colletidae), hoverflies (Syrphidae) and a skipper butterfly (Hesperiidae), probably feeding on nectar; probably pollinated by native bees and possibly hoverflies and small white butterfly (P. Kubiak pers. comm.).

Fruit/seed: Capsule, 5–9 mm long; seeds pale yellow, 2.5 mm long, January.

Dispersal, establishment & growth: Diaspore: seed, no particular mechanism for dispersal (McIntyre et al. 1995). ?Myrmecochore (Rice & Westoby 1981), though the mucilaginous rim or wing thought by Westoby et al. to be a possible adaptation to ant-dispersal may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).

Fire response: Regrowth and suckers from rootstocks and lateral roots, but fire appeared to retard vegetative multiplication since increases in population were greatest in unburnt quadrats; seedlings recorded less than 1 year after fire (Purdie 1977), resprouting plants reached maturity in about 2 years (P. Kubiak pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC CT ST NWS SWS; Vic., Qld.

Distribution Sydney area: Widespread.

Select locations: CC: Wisemans Ferry, Hornsby, Concord, Rockdale, East Hills, Toongabbie, Burragorang, Bargo, Albion Park (M. Robinson p.c.). CT: Hartley Vale, Kowmung River, Mt Jellore, Wingello.

Habitat

Habitat: Grassland, woodland, open-forest.

Altitude: 0–800 m

Annual rainfall: 800–1400 mm

Typical local abundance: Frequent to occasional.

Vegetation: Grassland e.g. with *Themeda australis*, woodland; open-forest e.g. with *Eucalyptus tereticornis*, *E. eugenioides*, *E. longifolia*, *Melaleuca decora* (A. Bofeldt & M. Robinson pers. comm.).

Substrate: Sandy to clayey soil, low to medium nutrients. Berry siltstone in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Partial shade to full sun (A. Bofeldt & M. Robinson pers. comm.).

Conservation

Conservation: Generally adequately conserved (R. Carolin pers. comm.), but not conserved in Illawarra where habitat is vulnerable (A. Bofeldt & M. Robinson pers. comm.).

Goodenia heterophylla* subsp. *eglandulosa**GOODENIACEAE****Life history**

Growth form: Woody, hairy herb to 40 cm high.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Yellow, August–May. Insect-pollinated (Haviland 1885).

Fruit/seed: Capsule, 3 mm long, with pale yellow seeds 2 mm long.

Dispersal, establishment & growth: Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CWS.

Distribution Sydney area: Coast and Woronora Plateau.

Select locations: CC: La Perouse, Lady Robinsons Beach, Kogarah, Panania, Tahmoor, Bargo, Kangaroo River, Berry.

Habitat

Habitat: Beaches and riverbanks.

Altitude: 0–200 m **Annual rainfall:** 900–1400 mm

Typical local abundance: Frequent to occasional.

Vegetation: Open-forest and woodland.

Substrate: Deep coastal sands and Permian sandstones, low nutrients.

Exposure:

Conservation

Conservation: Conservation status unknown.

Goodenia heterophylla subsp. *heterophylla*

GOODENIACEAE

Life history

Growth form: Woody, hairy herb to 40 cm high.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Yellow, August–May. Insect-pollinated (Haviland 1885).

Fruit/seed: Capsule, 3 mm long with pale yellow seeds 2 mm long.

Dispersal, establishment & growth: Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).

Fire response: Resprouted from base after high intensity fire (1/94) at Narrabeen and Lane Cove, with mature fruit in less than 2 years; peak of post-fire flowering 2–3 years (P. Kubiak pers. comm.).

Interaction with other organisms: Some plants eaten by rabbits; flowers visited by small black ?native bees (?Euryglossinae, ?Colletidae) and hoverflies (Syrphidae) probably for nectar, possibly pollinated by native bees and hoverflies (P. Kubiak pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC CT.

Distribution Sydney area: Widespread, Hornsby Plateau, Blue Mountains.

Select locations: CC: Morisset, Ourimbah, Yengo, Howes Valley, Pymble, Manly, Homebush, Bulli Pass, Kurrajong Heights, Wentworth Falls. CT: Mt Wilson.

Habitat

Habitat: Ridges, plateaus, hillsides.

Altitude: 0–1000 m **Annual rainfall:** 900–1400 mm

Typical local abundance: Frequent to occasional.

Vegetation: Open-forest e.g. with *Eucalyptus piperita*, *Angophora costata*, *Eucalyptus pilularis*, *E. saligna*.

Substrate: Sandy loam over sandstone, Wianamatta Shale, low to medium nutrients.

Exposure: Light shade (R. Carolin pers. comm.).

Conservation

Conservation: Adequately conserved (R. Carolin pers. comm.).

Goodenia heterophylla* subsp. *montana

GOODENIACEAE

Life history**Growth form:** Woody, hairy herb to 40 cm high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Yellow, September–March. Insect-pollinated (Haviland 1885).**Fruit/seed:** Capsule, 3 mm long, with pale yellow seeds, 2 mm long.**Dispersal, establishment & growth:** Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** CT ST.**Distribution Sydney area:** Upper Blue Mountains, Southern Highlands.**Select locations:** CT: Mt Coricudgy, Hassans Walls, Narrownneck, Yerranderie, Moss Vale, Wingello.**Habitat****Habitat:** Hillsides, moist gullies and on quite level ground (R. Carolin pers. comm.).**Altitude:** 600–1000 m**Annual rainfall:** 800–1200 mm**Typical local abundance:** Frequent to occasional.**Vegetation:** Open-forest e.g. with *Eucalyptus sieberi*, *Leptospermum trinervium*, *Telopea speciosissima*, *Banksia serrata*.**Substrate:** Sandy soil on sandstone.**Exposure:** Light shade (R. Carolin pers. comm.).**Conservation****Conservation:** Conserved in Blue Mountains NP and Wollemi NP (R. Carolin pers. comm.).***Goodenia macbarronii***

GOODENIACEAE

Life history**Growth form:** Herb to 30 cm high, with mostly basal leaves.**Vegetative spread:****Longevity:** Less than 1 year.**Primary juvenile period:** Less than 1 year.**Flowers:** Yellow, October–March. Insect-pollinated (Haviland 1885).**Fruit/seed:** Ovoid capsule 3–4 mm long, with yellow-brown seeds.**Dispersal, establishment & growth:** Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** ST CT; Vic.**Distribution Sydney area:** Orange area.**Select locations:** CT: Milthorpe (1923).**Habitat****Habitat:** Seepages (R. Carolin pers. comm.).**Altitude:** 800 m**Annual rainfall:** 1000 mm**Typical local abundance:****Vegetation:****Substrate:** Damp sandy soils.**Exposure:****Conservation****Conservation:** Rare, listed under schedule II, NSW Threatened Species Conservation Act 1995.

Coded 3VC- on national rare species list (Briggs & Leigh 1996). Only one record for Sydney area.

Goodenia ovata

GOODENIACEAE

Life history

Growth form: Erect, ascending, or prostrate shrub to 2 m high, viscid, often varnished. Leaves exude considerable quantity of resin making plant quite sticky (Maiden & Campbell 1898).

Vegetative spread: No.

Longevity:

Primary juvenile period: 3 years (P. Kubiak pers. comm.).

Flowers: Yellow, at any time of year, mainly September–December. Insect-pollinated (Haviland 1885). Flowers visited by honey bees (*Apis mellifera*) for nectar, also visited by black native bee (?Euryglossinae, ?Colletidae) and hoverflies (Syrphidae) (P. Kubiak pers. comm.).

Fruit/seed: Cylindrical capsule, 8–12 mm long, bristly, pale brown seeds 2 mm long.

Dispersal, establishment & growth: Diaspore: seed, ant-adapted food body for dispersal (Westoby et al. 1990), though the mucilaginous rim or wing thought by Westoby et al. to be an adaptation to ant-dispersal may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.). Germinated prolifically after bulldozing (M. Robinson pers. comm.).

Fire response: Killed (St Albans 1994, E. Ashby pers. comm.). Killed by high intensity fire (1/94) at Narrabeen and Lane Cove, seedlings within 5 months with green fruit in less than 3 years (P. Kubiak pers. comm.).

Interaction with other organisms: Foodplant of tiger moth caterpillar *Spilosoma glatignyi* (Coupar & Coupar 1992). Egg-shaped galls on stems; W. Froggatt reported Egyptian Mealy-bug *Icerya aegyptiacum* on plant (Maiden & Campbell 1898).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWS SWP SFWP; Qld, Vic., Tas., S.A.

Distribution Sydney area: Widespread.

Select locations: CC: Putty, Ourimbah, Barrenjoey, Beecroft, East Hills, Otford, Erskine Creek, Wallacia, Thirlmere, Kangaroo River. CT: Katoomba Falls, Kandos, Bundanoon, Wingello. Robertson Plateau (Kodala 1990a).

Habitat

Habitat: Cliff tops, hillsides, creekbanks, roadsides.

Altitude: 0–1000 m **Annual rainfall:** 900–1400 mm

Typical local abundance: Frequent to occasional.

Vegetation: Moist eucalypt forest e.g. with *Syncarpia glomulifera*, *Eucalyptus pilularis*; grassland e.g. with *Themeda australis* on steep rocky hillsides near sea; estuarine open-forest with *Casuarina glauca*; or *Eucalyptus tereticornis*, *E. eugenioides*, *E. longifolia* (A. Bofeldt & M. Robinson pers. comm.).

Substrate: Clay soil from shales, volcanic neck, medium nutrients, well-drained. On Berry Siltstone, Coal Measures or Budgong Sanstone in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Light shade.

Conservation

Conservation: Adequately conserved in the Sydney region (R. Carolin pers. comm.).

Goodenia paniculata

GOODENIACEAE

Life history

Growth form: Herb to 50 cm high, with short taproot and numerous adventitious roots.

Vegetative spread:

Longevity: Short-lived.

Primary juvenile period:

Flowers: Yellow, October–April. Insect-pollinated (Haviland 1885).

Fruit/seed: Capsule 5–6 mm long, with brown seeds.

Dispersal, establishment & growth: Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).

Fire response: Resprouts at base or below (Fox 1988). Possibly resprouted after high intensity fire (1/94) at Narrabeen, some flowering in 10–20 weeks (P. Kubiak pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CT NWS; Vic., Qld.

Distribution Sydney area: Mainly coastal.

Select locations: CC: Gosford, Hornsby, Dee Why, Auburn, Sans Souci, Taren Pt, Glenfield, Menangle, Richmond, Rooty Hill, Picton Lakes, Albion Park (M. Robinson p.c.). CT: Lawson, Mittagong, Wingello.

Habitat

Habitat: Wetland, swampland.

Altitude: 0–900 m

Annual rainfall: 600–1200 mm

Typical local abundance: Frequent–occasional.

Vegetation: Heath (R. Carolin pers. comm.); woodland e.g. with *Eucalyptus eugenioides*, *E. fibrosa*, *Melaleuca nodosa*, *M. deanei*, *Leptospermum polygalifolia*; or grassland. open-forest e.g. with *Eucalyptus tereticornis*, *E. eugenioides*, *E. longifolia*, *Melaleuca decora* (M. Robinson pers. comm.).

Substrate: Clay to sandy soils on shale, alluvium, freshwater swamp. Colonises low pH (2.5–6.5) acid sulphate estuarine soils in the Wyong area (Payne 1992). Berry Siltstone in Illawarra (M. Robinson pers. comm.). Recorded on saline sites in western NSW (Semple 1993).

Exposure: Full sun (M. Robinson pers. comm.).

Conservation

Conservation:

Goodenia pinnatifida

GOODENIACEAE

Life history

Growth form: Spreading to ascending herb to 40 cm high; basal leaves lobed, 5–8 cm long.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Bright yellow, September–November. Insect-pollinated (Haviland 1885).

Fruit/seed: Capsule, 8 mm long; brown, with glossy black seeds 5 mm diam., November.

Dispersal, establishment & growth: Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NT CT ST NWS CWS SWS NWP SWP NFWP SFWP.

Distribution Sydney area: Bathurst–Rylstone.

Select locations: CT: Rylstone, Glen Davis, Georges Plains.

		Habitat
Habitat:		
Altitude: 600–800 m	Annual rainfall: 600–800 mm	
Typical local abundance:		
Vegetation: Grassland and woodland e.g. with <i>Eucalyptus albens</i> , <i>Calotis lappulacea</i> .		
Substrate: Clay loam, probably on shales and granites. Recorded on saline sites in western NSW (Semple 1993).		
Exposure:		
		Conservation
Conservation: Rare in Sydney region, main occurrence is further west on slopes and plains.		

Goodenia rostrivalvis

GOODENIACEAE

		Life history
Growth form: Glossy shrub to 60 cm high.		
Vegetative spread:		
Longevity:		
Primary juvenile period:		
Flowers: Yellow, November–January. Insect-pollinated (Haviland 1885).		
Fruit/seed: Capsule, 10 mm long; brown, with glossy seeds 1.5 mm long.		
Dispersal, establishment & growth: Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).		
Fire response:		
Interaction with other organisms:		
		Distribution
Status/origin: Native.		
Botanical subregions: CT.		
Distribution Sydney area: Blue Mountains.		
Select locations: CT: Lawson, Wentworth Falls.		
		Habitat
Habitat: Damp south-facing sandstone cliffs.		
Altitude: 900–1000 m	Annual rainfall: 1200–1400 mm	
Typical local abundance: Rare–abundant (R. Carolin pers. comm.).		
Vegetation: Closed sedgeland and wet rockledges with <i>Gleichenia</i> , <i>Xyris ustulata</i> , <i>Epacris apiculata</i> , <i>Utricularia dichotoma</i> .		
Substrate: Sandstone cliffs and ledges, low nutrients, permanent moisture.		
Exposure: Sheltered.		
		Conservation
Conservation: Rare local endemic coded 2RCa on national rare species list (Briggs & Leigh 1996), confined to Wentworth Falls area and well conserved.		

Goodenia stelligera

GOODENIACEAE

Life history

Growth form: Erect herb to 60 cm high, with adventitious roots and mostly basal leaves.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Yellow, hairy, August–April, peak October. Insect-pollinated (Haviland 1885).

Fruit/seed: Capsule, 5–9 mm long with seeds 1.5 mm long, December–January.

Dispersal, establishment & growth: Diaspore: seed, adapted for ant-dispersal (Rice & Westoby 1981), though the mucilaginous rim or wing thought by Westoby et al. (1990) to be an adaptation to ant-dispersal may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).

Fire response: Flowering 31 weeks after high intensity fire (1/94) at Narrabeen (P. Kubiak pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC ST; Qld.

Distribution Sydney area: Coast, Broken Bay–Waterfall.

Select locations: CC: Hornsby, Narrabeen, North Head, Centennial Park (1898), La Perouse, Botany (1887), Blakehurst (1903), Sutherland, Waterfall.

Habitat

Habitat: Swamps

Altitude: 0–100 m

Annual rainfall: 1200–1600 mm

Typical local abundance: Frequent.

Vegetation: Scrub and shrubswamp e.g. with *Viminaria juncea*, *Gonocarpus salsoloides*, *Callistemon citrinus*, *Banksia robur*.

Substrate: Moist sand over Hawkesbury Sandstone, also on deeper sand deposits, low nutrients, impeded drainage.

Exposure: Full sun.

Conservation

Conservation: Restricted to coastal areas around Sydney but absent from sandstone habitats with similar appearance in Gosford area. Conserved in Royal NP, Ku-ring-gai Chase NP (R. Carolin pers. comm.).

Goodenia stephensonii

GOODENIACEAE

Life history

Growth form: Erect woody herb to 80 cm high

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Yellow, hairy, December. Insect-pollinated (Haviland 1885).

Fruit/seed: Capsule, 6 mm long with pale yellow, rough seeds 2 mm long.

Dispersal, establishment & growth: Diaspore: seed, with a mucilaginous rim or wing that may be a mechanism for absorbing water to secure germination and co-incidentally a dispersal temptation for ants (R. Carolin pers. comm.).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC.

Distribution Sydney area: Rylstone, Upper Hunter Valley, ?Gosford.

Select locations: CC: Bylong, Rylstone, Gosford (A specimen collected from Gosford in 1950 is the only location outside the upper Hunter Valley (Harden 1992) but the specimen is not referred to in Carolin, Rajput & Morrison 1992).

	Habitat
Habitat: Steep dry slopes.	
Altitude: 150–600 m	Annual rainfall: 500–600 mm
Typical local abundance: Frequent.	
Vegetation: Eucalypt open-woodland with shrubby understorey e.g. with <i>Eucalyptus punctata</i> , <i>E. sparsifolia</i> , <i>E. dawsonii</i> (McRae & Cooper 1985).	
Substrate: Sandy loam on Permain siltstones, low nutrients, well-drained.	
Exposure:	
	Conservation
Conservation: Rare. Probably not adequately conserved (R. Carolin pers. comm.).	

Scaevola aemula

GOODENIACEAE

	Life history
Growth form: Sprawling perennial herb to 50 cm high, with coarse yellow hairs on stems.	
Vegetative spread:	
Longevity:	
Primary juvenile period:	
Flowers: Blue or white, August–March.	
Fruit/seed: Ovoid hairy dry indehiscent fruit with 2 seeds.	
Dispersal, establishment & growth: Diaspore: fruit.	
Fire response:	
Interaction with other organisms:	
	Distribution
Status/origin: Native.	
Botanical subregions: NC CC SC ST CT; S.A., Vic.	
Distribution Sydney area: Southern Highlands.	
Select locations: CC: Fitzroy Falls CT: Wingello.	

	Habitat
Habitat:	
Altitude: 700–800 m	Annual rainfall: 1000–1400 mm
Typical local abundance: Frequent.	
Vegetation: Eucalypt open-forest.	
Substrate: Sandy loam over sandstone, low nutrients well-drained.	
Exposure:	
	Conservation
Conservation: A generally widespread species that has a restricted distribution within the Sydney area. Probably conserved in Moreton NP.	

Scaevola albida* var. *albida

GOODENIACEAE

Life history

Growth form: Herb to 50 cm high.**Vegetative spread:** Root-suckers.**Longevity:****Primary juvenile period:****Flowers:** Blue or white, October–April.**Fruit/seed:** 1-seeded dry indehiscent fruit, 3 mm long (R. Carolin pers. comm.).**Dispersal, establishment & growth:** Diaspore: fruit.**Fire response:** Probably resprouts at ground level or below.**Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** NC CC NT CT ST; S.A., Vic., Qld.**Distribution Sydney area:** Coast, Cumberland Plain, western Blue Mountains.**Select locations:** CC: Terrigal, Turrimetta Head, Concord (1911), Glenfield, Prospect, Campbelltown, Razorback, Glenbrook. CT: Blackheath, Jenolan River, Clandulla.

Habitat

Habitat: Grassland or woodlands, coastal headlands.**Altitude:** 0–600 m**Annual rainfall:** above 700 mm**Typical local abundance:** Occasional.**Vegetation:** Open grassland e.g. with *Themeda australis*, or eucalypt woodland e.g. with *Eucalyptus eugenioides*, *E. fibrosa*, *E. moluccana*, *E. tereticornis*, *E. melliodora*, grassy-herbaceous understorey or Melaleuca scrub, or on grassy headlands.**Substrate:** Mostly clay loam from Wianamatta Shale, basalt, volcanics, quartzite, claystones, also sand. Soil fertile, well drained. Watertable mostly low, moisture supply intermittent, fresh.**Exposure:** Sheltered situations, mid to light shade to full sun.

Conservation

Conservation: Vulnerable in Western Sydney (Benson & McDougall 1991), status elsewhere unknown.***Scaevola albida* var. *pallida***

GOODENIACEAE

Life history

Growth form: Herb to 50 cm high, sometimes trailing or prostrate.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Blue or white, December–March.**Fruit/seed:** 1-seeded indehiscent fruit, 3 mm long,**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution

Status/origin:**Botanical subregions:** CT ST; Vic., Tas., S.A.**Distribution Sydney area:** Southwest of the area.**Select locations:** CT: Hilltop, Yerranderie, Abercrombie Caves, Bungonia Lookout.

Habitat

Habitat: Hillsides, clifftops.**Altitude:** 600–800 m**Annual rainfall:** 700–900 mm**Typical local abundance:** Occasional–frequent.**Vegetation:** Moist to dry open-forest.**Substrate:** Shallow soils on limestone rocks.**Exposure:** Full sun.

Conservation

Conservation: Not known.

Scaevola calandulacea

GOODENIACEAE

Life history

Growth form: Prostrate shrub with stems to 40 cm high. Responds to sand accumulation with horizontal growth.

Vegetative spread: Roots along stems forming clumps or mats.

Longevity:

Primary juvenile period:

Flowers: Bright blue, throughout the year.

Fruit/seed: White and purplish, fleshy indehiscent fruit 12 mm diam. (R. Carolin pers. comm.).

Dispersal, establishment & growth: Diaspore: fruit, probably animal-dispersed. Vegetative dispersal by land-slip (Clarke 1989). Resprouts after cutting and grazing (Clarke 1989).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC; Vic., Qld.

Distribution Sydney area: Coast, Budgewoi to Austinmer.

Select locations: CC: Budgewoi, Avoca, Davistown, Dee Why, Lady Robinsons Beach (1915), Kurnell, Cronulla, Austinmer.

Habitat

Habitat: Coastal dunes and headlands.

Altitude: 0–100 m **Annual rainfall:** 1200–1600 mm

Typical local abundance: Frequent.

Vegetation: Coastal scrub e.g. with *Allocasuarina distyla*, *Acacia sophorae*, *Monotoca elliptica*, *Leptospermum laevigatum*, *Lomandra longifolia*, *Banksia integrifolia* and in open areas; or *Westringia fruticosa* (A. Bofeldt pers. comm.).

Substrate: Coastal sand dunes, sand and clay loam over sandstone, low nutrients.

Exposure: Seedlings sun-tolerant, wind-tolerant, shade-intolerant. Adults salinity-tolerant, waterlogging-intolerant (Clarke 1989).

Conservation

Conservation: Reported from Royal NP, but conservation status unknown.

Scaevola hookeri

GOODENIACEAE

Life history

Growth form: Prostrate perennial herb, with stolons to 30 cm long.

Vegetative spread: Roots at nodes, forming mats.

Longevity:

Primary juvenile period:

Flowers: White or blue with yellowish throat, December–March.

Fruit/seed: Hairy dry indehiscent fruit 2.5 mm long, often 1-seeded

Dispersal, establishment & growth: Diaspore: fruit.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC SC NT CT ST; Vic., Tas.

Distribution Sydney area: Upper Blue Mountains.

Select locations: CT: Wentworth Falls, Newnes Plateau.

Habitat

Habitat: Swamp margins, creek banks.

Altitude: 1000–1200 m **Annual rainfall:** 1000–1200 mm

Typical local abundance: Rare.

Vegetation: Moist swamp vegetation e.g. with *Gleichenia dicarpa*, *Acacia ptychoclada*.

Substrate: Sandy soil over sandstone, low nutrients, impeded drainage.

Exposure:

Conservation

Conservation: Rare, conservation status unknown.

Scaevola ramosissima

GOODENIACEAE

Life history

Growth form: Straggling or ascending herb to 40 cm high.

Vegetative spread: No.

Longevity:

Primary juvenile period:

Flowers: Pale violet to purple, August–March.

Fruit/seed: Ovoid fruit 5 mm long, November–March.

Dispersal, establishment & growth: Diaspore: fruit, with a powdery coating on capsule wall (J. Howell pers. comm.), adapted for ant-dispersal (Westoby et al. 1990).

Fire response: Resprouted from base after high intensity fire (1/94) at Narrabeen and Lane Cove, flowers within 5 months and green fruit in 1 year (P. Kubiak pers. comm.).

Interaction with other organisms: Heavily cropped by rabbits; flowers visited by small black ?native bees (?Euryglossinae, ?Colletidae) probably for nectar and pollen (P. Kubiak pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST; Vic., Qld.

Distribution Sydney area: Widespread.

Select locations: CC: Howes Valley, Dharug NP, Erina, Cowan, Frenchs Forest, Oatley, Wattamolla, Deadmans Creek, Yerranderie, Bilpin, Thirlmere, Cambewarra, Wentworth Falls. CT: Mittagong, Wingello.

Habitat

Habitat: Shrubby woodland.

Altitude: 0–1000 m

Annual rainfall: 900–1400 mm

Typical local abundance: Frequent to occasional.

Vegetation: Woodland e.g. with *Corymbia gummifera*, *C. eximia*, *Angophora bakeri*, *Angophora hispida*, *E. piperita*, and heath e.g. with *Allocasuarina uana*.

Substrate: Sandy soils over sandstone, low nutrients, well-drained.

Exposure:

Conservation

Conservation: Widespread and probably adequately conserved.

Selliera radicans

GOODENIACEAE

Life history

Growth form: Woody perennial herb with prostrate stems to 50 cm long.

Vegetative spread: Forms extensive mats by horizontal growth (P. Adam pers. comm.).

Longevity:

Primary juvenile period:

Flowers: Reddish brown outside, whitish inside, November–March.

Fruit/seed: Fleshy fruit 4–5 mm long; seeds brown 2 mm wide, very sticky when wet, November–March.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC SC ST.

Distribution Sydney area: Coast south from Gosford.

Select locations: CC: Point Clare, Avoca, Narrabeen, Iron Cove (1917), Maroubra, Cooks River (1912), La Prouse, Wollongong, Kembla Grange.

Habitat

Habitat: Salt marshes, bordering lakes, streams, seacliffs.

Altitude: 0–50 m **Annual rainfall:** 1000–1400 mm

Typical local abundance: Frequent.

Vegetation: Saltmarsh, coastal scrub e.g. with *Melaleuca nodosa*, *M. armillaris*, *Baeckea imbricata*, *Westringia fruticosa*; seacliffs on open rock shelves, on very shallow, sometimes poorly drained sandy soil e.g. with *Triglochin striata*, *Isolepis cernua*, *Sarcocornia*; as understorey in *Casuarina glauca* forest (P. Adam pers. comm.).

Substrate: Damp sandy loam of brackish estuarine sediments, medium nutrients. Shallow sand on cliffs (P. Adam pers. comm.). Quaternary alluvium, Latite in the Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Full sun to light shade.

Conservation

Conservation: Vales Point at Lake Macquarie is northern geographical limit.

Seacliffs are now its main habitat in the Sydney region. It is very rare on saltmarshes — although Hamilton recorded it quite widely, it seems to have declined considerably, largely due to loss or disturbance of saltmarshes but competition with *Hydrocotyle*, which occurs in very similar habitats, may be a factor (P. Adam pers. comm.).

Not conserved in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Velleia lyrata**GOODENIACEAE****Life history**

Growth form: Perennial herb.

Vegetative spread: No.

Longevity: Less than 5 years.

Primary juvenile period: 14 months (after fire at Brisbane Water, L.McD.).

Flowers: Yellow, October–January, peak November.

Fruit/seed: Capsule 3–6 mm diam; seeds 1–2.5 mm diam.

Dispersal, establishment & growth: Diaspore: seed, soil-stored seedbank. Recruitment episodic, mainly after fire.

Fire response: Killed. Flowers and fruits within 1 year after high intensity fire (1/94) at Lane Cove (P. Kubiak pers. comm.).

Interaction with other organisms: Stems, flowers, fruits and possibly leaves eaten by rabbits (P. Kubiak pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: CC; Qld.

Distribution Sydney area: Coast, Somersby to Sublime Point.

Select locations: CC: Mangrove Mountain, Wondabyne, Narrabeen, Epping, Mosman (1903), Randwick (1898), Waterfall, Sublime Point (1934), near Richmond (1892).

Habitat

Habitat: Moist shrubland.

Altitude: 0–100 m **Annual rainfall:** 1200–1400 mm

Typical local abundance: Occasional.

Vegetation: Heath and scrub e.g. with *Banksia ericifolia*.

Substrate: Shallow soil on sandstone. Soil very infertile. Watertable mostly low, moisture supply intermittent, fresh.

Exposure: Full sun.

Conservation

Conservation: *Velleia lyrata* occurs only in the Sydney region and in south-east Queensland; Sublime Point is the southern geographical limit. Many Sydney area collections are old and it is now rare in the immediate Sydney area but probably conserved in Ku-ring-gai Chase NP and Brisbane Water NP (R. Carolin pers. comm.).

Conservation status in southeast Queensland is unknown.

Velleia montana

GOODENIACEAE

Life history

Growth form: Perennial herb, with flower stalks to 10 cm high.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Yellow, November–February.

Fruit/seed: Sparsely hairy capsule 2 mm diam., seeds 1.5 mm diam.

Dispersal, establishment & growth: Diaspore: seed (R. Carolin pers. comm.).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NT CT ST; Vic., Tas.

Distribution Sydney area: Upper Blue Mountains.

Select locations: CT: Clarence, Bindook Swamp, Mt Werong.

Habitat

Habitat: Moist treeless swamps.

Altitude: 1000–1200 m

Annual rainfall: above 1200 mm

Typical local abundance: Rare–occasional.

Vegetation: Moist treeless swamp.

Substrate: Probably sandy, infertile soils. Watertable mostly high, fresh.

Exposure:

Conservation

Conservation: Rare, and rarely collected with only 2/6 collections made since 1947.

Probably adequately conserved in Blue Mountains NP (R. Carolin pers. comm.).

Velleia paradoxa

GOODENIACEAE

Life history

Growth form: Softly hairy, perennial herb, with flower stalks to 40 cm high.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Yellow, mainly August–February (Harden 1992).

Fruit/seed: Hairy capsule 5 mm diam., seeds 3–5 mm diam.

Dispersal, establishment & growth: Diaspore: seed (R. Carolin pers. comm.).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC NT CT ST NWS CWS SWS NWP SWP NFWP; Qld, Vic, SA

Distribution Sydney area: Western Blue Mountains–Orange, also Campbelltown.

Select locations: CC: Menangle Road, Campbelltown (1893). CT: Orange (1945), Rockley (1906), Jenolan Caves (1899), Mt Macquarie near Carcoar (1907),

Habitat

Habitat:

Altitude: 0–1000 m

Annual rainfall: 700–1200 mm

Typical local abundance:

Vegetation: Eucalypt open-forest, grassland (Harden 1992).

Substrate:

Exposure:

Conservation

Conservation: Mainly old collections for Sydney area (no collections reported since 1945) and probably now rare. Probably poorly conserved in Sydney region (R. Carolin pers. comm.).

Velleia perfoliata

GOODENIACEAE

Life history

Growth form: Small perennial herb with short, thick rootstock and light green spoon-shaped leaves (Maryott-Brown & Wilks 1993).

Vegetative spread: No.

Longevity: Less than 5 years. J. Pickard reports on revisiting collecting site, 'the community of *Calytrix tetragona* had not been burnt in the time interval (3 yrs) and did not appear to have changed but there was no sign of *V. perfoliata*.' (Herb. note).

Primary juvenile period: Less than 1 year (Maryott-Brown & Wilks 1993).

Flowers: Yellow. Highly variable, peak usually spring to early summer.

Fruit/seed: Capsule 4 mm diam; seed 3 mm diam.

Dispersal, establishment & growth: Diaspore: seed, recruitment from soil-stored seedbank, dormancy broken by temperatures 80–110°C, or over time, germination 64–79% (Maryott-Brown & Wilks 1993).

Fire response: Probably killed and recruits from soil-stored seed.

Interaction with other organisms: Plants up-rooted at high visitation sites, mistaken for weeds (Maryott-Brown & Wilks 1993).

Distribution

Status/origin: Native.

Botanical subregions: CC CWS.

Distribution Sydney area: Wollombi to Colo area.

Select locations: CC: Wollombi, Upper Colo, Colo River near Putty Road.

Habitat

Habitat: Sandstone ridges, rock platforms, rocky hillsides.

Altitude: 0–300 m **Annual rainfall:** 600–1000 mm

Typical local abundance: Frequent.

Vegetation: Heath e.g. with *Calytrix tetragona*.

Substrate: Shallow sandy loam, pH 4.5 (Maryott-Brown & Wilks 1993), on sandstone, very infertile soil. Watertable mostly low, moisture supply intermittent, fresh.

Exposure:

Conservation

Conservation: Vulnerable species, listed under schedule 1, NSW Threatened Species Conservation Act 1995. Coded 2VC- on national rare species list (Briggs & Leigh 1996).

Velleia spathulata

GOODENIACEAE

Life history

Growth form: Perennial herb.**Vegetative spread:** No vegetative spread.**Longevity:****Primary juvenile period:****Flowers:** Yellow with purplish markings, at any time of year.**Fruit/seed:** Capsule 3 mm diam., seed 1.5 mm diam.**Dispersal, establishment & growth:** Diaspore: seed (R. Carolin pers. comm.).**Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** NC CC; Qld.**Distribution Sydney area:** Coastal.**Select locations:** CC: Catherine Hill Bay (1993), Narrabeen swamps (1900).

Habitat

Habitat: Coastal dunes.**Altitude:** 0–50 m**Annual rainfall:** above 1200 mm**Typical local abundance:****Vegetation:** Ground stratum.**Substrate:** Damp, sandy, infertile soils. Watertable mostly high.**Exposure:**

Conservation

Conservation: Rare, only 2 records for Sydney area, including southern geographical limit at Narrabeen. Probably now extinct in Sydney suburban area.*Codonocarpus attenuatus*

GYROSTEMONACEAE

Bell-fruit Tree

Life history

Growth form: Tree to 12 m high with bright green cone-shaped crown and pendent leaves; bark smooth, purple-brown, becoming corky.**Vegetative spread:****Longevity:** Short-lived (Floyd 1989).**Primary juvenile period:****Flowers:** Yellow-green male and female flowers usually on separate plants, November–February.**Fruit/seed:** Bell-shaped fruit 12–16 mm long, consisting of 40–50 thin wing-like carpels separating from each other when ripe and containing 2 mm diam. seed with aril at base. Mature August–February.**Dispersal, establishment & growth:** Diaspore: winged seed, wind-dispersed (Floyd 1989), probably has dormancy mechanism. Probably a coloniser. Common on steep basalt hillsides after clearing and burning (Floyd 1989).**Fire response:** Probably killed.**Interaction with other organisms:** Suspected of poisoning stock (Harden 1990).

Distribution

Status/origin: Native.**Botanical subregions:** NC CC NWS CWS NWP; Qld.**Distribution Sydney area:** Watagan Mountains, Macdonald area.**Select locations:** CC: Mt Warrawolong, Mt Wareng, Howes Valley (Carolin & Tindale 1993).

Habitat

Habitat: Dry rainforest.**Altitude:** 0–600 m**Annual rainfall:** 1400 mm**Typical local abundance:** Rare.**Vegetation:** Dry rainforest margins e.g. with *Synoum glandulosum*.**Substrate:** Red loam on volcanic basalt capping, high nutrients, well-drained.**Exposure:**

Conservation

Conservation: Occurrence in Sydney area, in Watagans, is southern geographical limit. Conservation status unknown.

Gyrostemon thesioides

GYROSTEMONACEAE

Life history

Growth form: Shrub with several stems to 70 cm high.
Vegetative spread: No.
Longevity: Apparently short-lived, 12 months (E.J. McBarron, Herb. note).
Primary juvenile period: 3–6 months.
Flowers: November–April, male and female flowers on separate plants.
Fruit/seed: Red brown fruit 2–2.5 mm long. Seed 2 mm long, mature December–June.
Dispersal, establishment & growth:
Fire response: Recruitment mainly after fire, most likely from seed.
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: CC; Vic., Tas., S.A., W.A.
Distribution Sydney area: Georges River.
Select locations: CC: Georges River (Ingleburn, 1967), Nepean River (Douglas Park, 1910).

Habitat

Habitat: Hillside near river and riverbank.
Altitude: 0–50 m **Annual rainfall:** 800 mm
Typical local abundance: Frequent.
Vegetation: With *Calotis dentex*, *Hybanthus* sp., *Dichelachne* sp.
Substrate: Sandy alluvium from sandstone. Infertile soil. Moisture supply intermittent, fresh.
Exposure:

Conservation

Conservation: Rare, only recently recorded population at Ingleburn recorded 1966–7, but not seen subsequently though collector revisited site at different times (E.J. McBarron, Herb note). Vulnerable and inadequately conserved.

Gonocarpus chinensis subsp. *verrucosus*

HALORAGACEAE

Life history

Growth form: Perennial herb 20–45 cm high.
Vegetative spread:
Longevity:
Primary juvenile period:
Flowers: Small, April.
Fruit/seed: One-seeded nut 1 mm diam., dark grey.
Dispersal, establishment & growth:
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: NC CC; Qld.
Distribution Sydney area:
Select locations: CC: Hawkesbury River (1919).

Habitat

Habitat: Swamp.
Altitude: 0–50 m **Annual rainfall:** 800–1200 mm
Typical local abundance:
Vegetation: Swamp.
Substrate: Probably sandy alluvium, poorly-drained, medium nutrients.
Exposure: Full sun.

Conservation

Conservation: Rare. Only one old record (1919) for this species at its southern geographical limit. Possibly extinct there now. Inadequately conserved.

Gonocarpus elatus

HALORAGACEAE

Life history

Growth form: Perennial herb or subshrub to 60 cm high**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Reddish brown, November.**Fruit/seed:** 1-seeded nut 1–1.5 mm long.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** NC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., S.A.**Distribution Sydney area:** Bathurst area.**Select locations:** CT: Winburndale NR (1977), Rockley (1906).

Habitat

Habitat:**Altitude:** 900–1000 m**Annual rainfall:** 600–900 mm**Typical local abundance:****Vegetation:****Substrate:** Dry rocky hillsides.**Exposure:**

Conservation

Conservation: Few records for Sydney area, though mainly occurring further west.

Conservation status unknown.

Gonocarpus humilis

HALORAGACEAE

Life history

Growth form: Prostrate to semi-prostrate perennial herb 20–30 cm high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Yellow-green, November–February.**Fruit/seed:** 1-seeded, 8-ribbed nut, silver-grey to purplish, 1.5 mm long.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** NC CC SC NT CT; Qld, Vic., Tas., S.A.**Distribution Sydney area:** Sporadic.**Select locations:** CC: Berowra Creek, Homebush Bay, Albion Park.

CT: Wingecarribee Swamp.

Habitat

Habitat: Damp places.**Altitude:** 0–700**Annual rainfall:** 1000–1600 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Open-forest e.g. with *Eucalyptus paniculata*, *E. punctata*, *E. resinifera*. Margins of saline flats or montane peatland.**Substrate:** Clayey, ironstone gravel soil on shales, medium–low nutrients.**Exposure:**

Conservation

Conservation: Unknown.

Gonocarpus longifolius

HALORAGACEAE

Life history

Growth form: Small, monoecious shrub.
Vegetative spread:
Longevity: probably short-lived.
Primary juvenile period:
Flowers: Greenish, October–December.
Fruit/seed: 1-seeded, siver-grey to reddish, 1 mm long.
Dispersal, establishment & growth: Diaspore: fruit. Coloniser of exposed sand at Menangle, but needs light and may be poor coloniser of disturbed sites elsewhere.
Fire response: Probably killed.
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: NC CC CT CWS.
Distribution Sydney area: Scattered.
Select locations: CC: Georges River, Nepean River, Menangle, Bents Basin, Douglas Park, Bargo, Burratorang Lookout. CT: Rylstone, Jenolan Caves, Yerranderie.

Habitat

Habitat: Dry riverbed and banks, clifftop.
Altitude: 0–700 mm **Annual rainfall:** 600–1400 mm
Typical local abundance: Frequent to occasional.
Vegetation: Eucalypt woodland e.g. with *Eucalyptus punctata*, *Zieria compacta*.
Substrate: Alluvial sand, slate, sandstone, low nutrients.
Exposure:

Conservation

Conservation: Coded 3RC- on national rare species list (Briggs & Leigh 1996).
Vulnerable in Western Sydney (Benson & McDougall 1991).

Gonocarpus micranthus* subsp. *micranthus

HALORAGACEAE

Life history**Growth form:** Herb, usually prostrate, to 10 cm high.**Vegetative spread:** Yes (McIntyre et al. 1995), mat-forming, stem-rooting.**Longevity:** Less than 5 years (D. Keith pers. comm.).**Primary juvenile period:** Primary juvenile period 1–2 years (D. Keith pers. comm.).**Flowers:** Reddish, September–February, peak December.**Fruit/seed:** 1-seeded, 8-ribbed nut, reddish to grey, 1 mm long.**Dispersal, establishment & growth:** Diaspore: fruit. No particular mechanism for dispersal (McIntyre et al. 1995). Non-dormant fraction of total seed crop 0%, recruitment episodic, mainly after fire (D. Keith pers. comm.).**Fire response:** Killed (D. Keith pers. comm.). Probably killed after high intensity fire (1/94) at Lane Cove and Narrabeen, seedlings seen within 3 months, flowering in 10–14 months (P. Kubiak pers. comm.).**Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT ST SWS; Qld, Vic., Tas., S.A., N.Z., NG, Malesia, Asia.**Distribution Sydney area:** Widespread.**Select locations:** CC: Colo, Asquith, Wahroonga, Forestville (L.McD.). CT: Linden, Lidsdale, Kanangra Walls, Wilton, Bundanoon, Long Swamp, Boyd Plateau swamps (Kodala et al. 1992, Kodala et al. 1996).**Habitat****Habitat:** Wet places in open or grassy situations.**Altitude:** 0–1000 m**Annual rainfall:** 800–1400 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Eucalypt open-forest e.g. with *Eucalyptus piperita*, *Angophora costata*, *Allocasuarina littoralis*, heath e.g. with *Darwinia grandiflora*, *Leptospermum polygalifolium*, *Actinotus minor*, *Helichrysum diosmifolium*; sedgeland / wet heath swamps on Boyd Plateau (P. Kodala pers. comm.).**Substrate:** Sandy soil, sandstone, granite, moist to dry conditions. Margin of upland mire (Kodala 1992), peat and peat soils overlying granite (Kodala et al. 1996).**Exposure:** Full sun.**Conservation****Conservation:** Status unknown.***Gonocarpus micranthus* subsp. *ramosissimus***

HALORAGACEAE

Life history**Growth form:** Erect herb, 25–60 cm high.**Vegetative spread:** Yes (McIntyre et al. 1995).**Longevity:****Primary juvenile period:****Flowers:** Reddish, January–March.**Fruit/seed:** 1-seeded nut, reddish to grey, 1 mm long, February–March.**Dispersal, establishment & growth:** Diaspore: fruit. No particular mechanism for dispersal (McIntyre et al. 1995).**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT NWS; Qld.**Distribution Sydney area:** Mainly coast.**Select locations:** CC: Morisset, Putty, Mellong Swamps, Mitchell Park (Cattai NP, L.McD.), Gosford, Narrabeen, Sans Souci, Waterfall, Thirlmere Lakes. CT: Wingello.

Habitat

Habitat: Damp places

Altitude: 0–700 m

Annual rainfall: 800–1200 mm

Typical local abundance: Frequent–occasional.

Vegetation: Eucalypt open-forest, shrubswamp e.g. with *Eucalyptus pauciflora*.

Substrate: Moist sandy soil on sand, sandstones, in humic sands on edge of freshwater swamp.

Exposure: Full sun to light shade.

Conservation

Conservation:

Gonocarpus salsoloides

HALORAGACEAE

Life history

Growth form: Erect or ascending, much-branched herb to 40 cm high.

Vegetative spread:

Longevity: 5–20 years (D. Keith pers. comm.).

Primary juvenile period: Primary juvenile period 1–3 years (D. Keith pers. comm.).

Flowers: Red-brown to yellowish, May–November, peak August. This species is unique in the genus in that although the flowers are apparently bisexual, the plants are functionally dioecious due to abortion of stamens or ovary (Orchard 1990b).

Fruit/seed: Oval, 8-ribbed, 1-seeded nut 1–1.5 mm long.

Dispersal, establishment & growth: Diaspore: fruit. Recruitment probably episodic following fire or perhaps removal of vegetation.

Fire response: Killed by fire followed by main recruitment (D. Keith pers. comm.).

Probably killed after high intensity fire (1/94) at Narrabeen, seedlings seen c. 4 months (P. Kubiak pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC.

Distribution Sydney area: Coast.

Select locations: CC: Somersby, Wondabyne, Manly Dam, Botany (1888), La Perouse, Anise Falls (RNP), Darkes Forest.

Habitat

Habitat: Swampy areas.

Altitude: 0–100 m

Annual rainfall: 1200 1600 mm

Typical local abundance: Frequent–occasional.

Vegetation: Very localised in swampland and sedgeland e.g. with *Sprengelia incarnata*, *Gymnoschoenus sphaerocephalus*, *Viminaria juncea*, *Lepyrodia scariosa*, *Baumea acuta*, *Hakea teretifolia*.

Substrate: Swampy areas on deep sands or sand over sandstone, low nutrients, poorly-drained.

Exposure: Full sun.

Conservation

Conservation: Coded 3RCa on national rare species list (Briggs & Leigh 1996).

Southern geographical limit is Darkes Forest. Vulnerable to catchment disturbance — many swamp habitats threatened by development.

Gonocarpus tetragynus**HALORAGACEAE****Life history**

Growth form: Perennial herb 15–30 cm high; stems with appressed hairs.

Vegetative spread: Yes (McIntyre et al. 1995).

Longevity: Indefinite (D. Keith pers. comm.)

Primary juvenile period:

Flowers: Green to red, October–December.

Fruit/seed: 1-seeded, silver-grey, 1–1.5 mm long.

Dispersal, establishment & growth: Diaspore: fruit. No particular dispersal mechanism (McIntyre et al. 1995). Episodic recruitment mainly after fire (D. Keith pers. comm.).

May occur on disturbed sites

Fire response: Regrowth and suckers from rootstocks and lateral roots, seedlings recorded less than 1 year after fire (Purdie 1977). Secondary juvenile period 2 years.

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST CWS SWS; Qld, Vic., Tas., S.A.

Distribution Sydney area: Widespread.

Select locations: CC: Wyong, Hornsby, Pennant Hills, Hurstville, St Marys, Fairfield, Fitzroy Falls. CT: Blackheath, Mt Wilson, Hartley, Orange, Long Swamp (Kodala et al. 1992).

Habitat

Habitat: Forest and heath.

Altitude: 0–1000 m

Annual rainfall: 800–1600 mm

Typical local abundance: Frequent–occasional.

Vegetation: Eucalypt open-forest e.g. with *Eucalyptus punctata*, *E. paniculata*, *E. macrorhyncha*, *E. rossii*, heath e.g. with *Grevillea acanthifolia*, *Hakea teretifolia*.

Substrate: Dry gravelly soils on sandstone, shale, granite, sometimes swampy.

Exposure:

Conservation

Conservation: Widespread and probably adequately conserved.

Gonocarpus teucroides**HALORAGACEAE****Life history**

Growth form: Erect multistemmed herb or subshrub 20–40 cm high; stems with spreading hairs.

Vegetative spread:

Longevity: 5–20 years (D. Keith pers. comm.).

Primary juvenile period: 2–4 years (Benson 1985).

Flowers: Green to red, July–January. Honeybees and native bees may play an incidental role in pollination (P. Kubiak pers. comm.).

Fruit/seed: 1-seeded nut, silver-grey, 1.5 mm long, October–March.

Dispersal, establishment & growth: Diaspore: fruit. No special morphology for dispersal (Westoby et al. 1990). No seed dormancy, episodic recruitment mainly after fire (D. Keith pers. comm.).

Fire response: Killed (D. Keith pers. comm., Fox 1988). Some plants e.g. in rock crevice resprouted from base, probably at lower intensity fire, and seedlings within 10 weeks after high-intensity fire (1/94) at Lane Cove, Narrabeen 1994; peak flowering 2–3 years, beginning to fruit less than 2 years (P. Kubiak pers. comm.).

Interaction with other organisms: Foodplant of moth larvae *Eutrichopidia latinus* (Common 1990). Moth, probably *Eutrichopidia latinus* (Noctuidae) reported laying eggs on plant; large quantities eaten by rabbits (P. Kubiak pers. comm.).

		Distribution
Status/origin: Native.		
Botanical subregions: NC CC SC NT CT ST; Qld, Vic, Tas.		
Distribution Sydney area: Mainly coast, also Blue Mountains, and Robertson Plateau (Kodela 1990a).		
Select locations: CC: Woy Woy, Cowan, Berowra, Hornsby, Cheltenham, Roseville, Manly, Springwood. CT: Leura, Mittagong.		
		Habitat
Habitat: Open-forest.		
Altitude: 0–1000 m	Annual rainfall: 900–1400 mm	
Typical local abundance: Frequent–occasional.		
Vegetation: Eucalypt open-forest e.g. with <i>Syncarpia glomulifera</i> , <i>Angophora costata</i> , <i>Eucalyptus robusta</i> , <i>Acacia elata</i> , <i>Allocasuarina</i> , <i>Pteridium</i> .		
Substrate: Sandy soil, deep white sand on sandstone, Narrabeen Shale, low to medium nutrients.		
Exposure: Full sun.		
		Conservation
Conservation: Probably adequately conserved.		

Haloragis aspera

HALORAGACEAE

		Life history
Growth form: Perennial herb 15–30 cm high, with annual stems arising from deeply buried rhizomes. Intergrades with <i>H. glauca</i> and <i>H. heterophylla</i> .		
Vegetative spread: Rhizomatous spread.		
Longevity: Indeterminate.		
Primary juvenile period:		
Flowers: Green to red, November–June.		
Fruit/seed: Nut 2.5–3.5 mm long,		
Dispersal, establishment & growth:		
Fire response:		
Interaction with other organisms:		
		Distribution
Status/origin: Native.		
Botanical subregions: NC CC NWS CWS NWP SWP NFWP SFWP; Qld, Vic., Tas., N.T., S.A., W.A.		
Distribution Sydney area: Cumberland Plain, Western Sydney.		
Select locations: CC: Werrington, Macquarie Fields, Minto, Camden, Menangle.		
		Habitat
Habitat: Watercourses.		
Altitude: 0–200 m	Annual rainfall: 700–900 mm	
Typical local abundance:		
Vegetation:		
Substrate: Damp sandy soil on alluvium.		
Exposure:		
		Conservation
Conservation: Probably rare in Western Sydney, conservation status unknown.		

Haloragis exalata subsp. *exalata* var. *exalata*

HALORAGACEAE

Life history

Growth form: Shrub to 1.5 m high, with square stems and opposite leaves.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Yellowish green to reddish, December.**Fruit/seed:** Nut 2–2.5 mm long.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** CC SC NWS; Vic.**Distribution Sydney area:****Select locations:** CC: Clifton (1892).

Habitat

Habitat: Damp places near watercourses.**Altitude:** 0–100 m**Annual rainfall:** 1400 mm**Typical local abundance:****Vegetation:****Substrate:****Exposure:**

Conservation

Conservation: Listed under schedule II, NSW Threatened Species Conservation Act 1995. Coded 3VCa on national rare species list (Briggs & Leigh 1996). Only Sydney record is for Clifton (1892).*Haloragis exalata* subsp. *exalata* var. *laevis*

HALORAGACEAE

Life history

Growth form: Shrub to 1.5 m high, with square stems and opposite leaves.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Yellowish green to reddish.**Fruit/seed:****Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** CC.**Distribution Sydney area:** Nepean River, Kangaroo River.**Select locations:** CC: Parramatta (W. Woolls), Nepean River (W. Woolls), Tallowa Dam (Mills).

Habitat

Habitat:**Altitude:** 0–200 m**Annual rainfall:** 800–1600 mm**Typical local abundance:****Vegetation:****Substrate:****Exposure:**

Conservation

Conservation: Local endemic, coded 3VCa on national rare species list (Briggs & Leigh 1996). Records by W. Woolls were made in the late 19th century but there is a recent record for Tallowa Dam on the Kangaroo River. Rare and possibly extinct in Nepean River area.

Haloragis heterophylla

HALORAGACEAE

Life history

Growth form: Perennial herb 15–50 cm high, with stems arising from rhizomes.

Some intergrades with *H. aspera*.

Vegetative spread: No (McIntyre et al. 1995).

Longevity: Possibly short-lived.

Primary juvenile period:

Flowers: Red, December–March.

Fruit/seed: Nut 1.5–2.5 mm long, December–March.

Dispersal, establishment & growth: No particular mechanism for dispersal (McIntyre et al. 1995).

Fire response: Probably killed.

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., Tas., S.A.

Distribution Sydney area: Cumberland Plain, western Sydney.

Select locations: CC: Agnes Banks, Toongabbie, Doonside, Elderslie, West Dapto, Gerringong. CT: Bathurst, Orange, Blayney, Robertson, Wildes Meadow.

Habitat

Habitat: Swamp margins and depressions, drainage channels.

Altitude: 0–1000 m

Annual rainfall: 600–1600 mm

Typical local abundance:

Vegetation: Eucalypt woodland e.g. with *Eucalyptus parramattensis*, *Melaleuca decora* or *E. radiata*, *E. ovata*.

Substrate: Clay loam on shale, alluvium, poorly drained sites, probably medium to low nutrient soils. Recorded on saline sites in western NSW (Semple 1993).

Exposure:

Conservation

Conservation: Although widespread in Victoria and eastern New South Wales it is now rare in the Sydney district because of habitat destruction.

Vulnerable in Western Sydney (Benson & McDougall 1991).

Haloragis serra

HALORAGACEAE

Life history

Growth form: Erect perennial herb or subshrub to 60 cm high, with stoloniferous roots.

Vegetative spread: Spreads by stolons.

Longevity: Indefinite.

Primary juvenile period:

Flowers: Yellow-green, November–March.

Fruit/seed: Nut 2–3 mm long,

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC CT ST NWS CWS SWS.

Distribution Sydney area:

Select locations: CC: Marramarra Creek. CT: Jenolan Caves, Abercrombie Caves, Pantoneys Crown.

Habitat

Habitat: Rocky outcrops.

Altitude: 0–800 m

Annual rainfall: 800–1000 mm

Typical local abundance: Rare–occasional.

Vegetation: Woodland e.g. with *Eucalyptus albens*, *Bursaria spinosa* or *Eucalyptus tereticornis*, *E. beyeriana*.

Substrate: Clay soils on limestone, rocky outcrops, alluvial soil from Narrabeen Shales (Marramarra).

Exposure: Light shade to full sun, but dies out if overshadowed by dense growth.

Conservation

Conservation: Occurrence at Big Bay in Marramarra NP near old habitation site may possibly be introduced though site is just above high water mark and may have localised calcareous deposits from old middens suggesting affinities with the limestone sites elsewhere.

Haloragodendron lucasii

HALORAGACEAE

Life history

Growth form: Straggling shrub to 1–1.5 m high, with 4-angled stems. Plant collected at Mt Wilson with smaller flowers and unwinged fruits may be distinct subspecies (Harden 1991).

Vegetative spread: Suckers from roots. Populations are clones with only 6 genetically distinct individuals in the coastal populations in the Sydney area (Sydes et al. 1996).

Longevity: Clonal plants may exceed 450 years (Peakall & Sydes 1996).

Primary juvenile period:

Flowers: Creamy-white, October. Coastal populations male sterile and don't set seed, hermaphrodite in mountain populations (P. Wilson pers. comm.).

Fruit/seed: Winged fruit 5 mm long, November–December. Mature fruit not produced in Sydney populations (Peakall & Sydes 1996).

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC CT.

Distribution Sydney area: St Ives–Turramurra, Wollangambe Wilderness.

Select locations: CC: St Ives, North Turramurra. CT: Bungleboori Creek.

Habitat**Habitat:** Sheltered slopes near creeks.**Altitude:** 0–800 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Frequent.**Vegetation:** Low woodland e.g. with *Eucalyptus piperita*, *Angophora costata*, *Corymbia gunnifera*, with dense *Gleichenia* fern thicket at St Ives, heath *Allocasuarina distyla*, *Banksia ericifolia*, *Leptospermum trinervium* (Wollangambe), or in open-forest e.g. with *Eucalyptus oreades*, *Ceratopetalum apetalum*, *Logania albiflora*, *Todea barbara* (Wollangambe).**Substrate:** Moist loamy sand on bench below small broken sandstone cliffines, with moisture supply from continuous seepage, also moist habitat may have enabled populations to survive during dry periods.**Exposure:** Light shade.**Conservation****Conservation:** Local endemic listed under schedule I, NSW Threatened Species Conservation Act 1995. Coded 2ECi on national rare species list (Briggs & Leigh 1996), rediscovered in Davidson SRA, now Garigal NP, in 1986 after being unrecorded for 60 years (Orchard 1990a). The Bungleboorie Creek population may differ slightly from the coastal populations.***Myriophyllum aquaticum* *****HALORAGACEAE**

Parrots Feather, Brazilian Water-milfoil

Life history**Growth form:** Stout aquatic herb, with floating stems to 2 m long, leaves with feathery appearance.**Vegetative spread:** Roots freely from lower nodes of stem.**Longevity:** Indefinite.**Primary juvenile period:** Not relevant in Australia.**Flowers:** Male and female flowers on separate plants, but male plants not present in Australia; main flowering November–December but sometimes as late as April (Orchard 1985).**Fruit/seed:** Fruit not formed in Australia.**Dispersal, establishment & growth:** Reproduction is entirely vegetative by stem fragments; the stems are brittle and spread occurs as floating mats break up (Orchard 1985). Dense growth can usually be attributed to high nutrient levels (Sainty & Jacobs 1981).**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to central S America.**Botanical subregions:** NC CC NT; Qld, Vic., Tas., W.A.**Distribution Sydney area:** Coast and Hawkesbury Nepean floodplain.**Select locations:** CC: Windsor, Pitt Town, Gosford, Centennial Park, Mascot, Earlwood, Liverpool, Casula.**Habitat****Habitat:** Wetlands, creeks.**Altitude:** 0–200 m**Annual rainfall:** 800–1200 mm**Typical local abundance:** Frequent.**Vegetation:** Fresh water sedgeland with other floating and emergent aquatic plants e.g. *Ludwigia peploides*, *Marsilea mutica*, *Eleocharis* sp. etc.**Substrate:** Mud or still water, slow water, rooting in the shallows with stems floating out over deeper water to form dense tangled rafts on the surface (Orchard 1985).**Exposure:** Full sun.**Conservation****Conservation:** Naturalised for many years but seldom reported as troublesome though may outcompete native species in wetlands. Care should be taken to prevent further imports; if male plants become established seeds could be produced with as yet unknown consequences (Sainty & Jacobs 1981).

Myriophyllum caput-medusae

HALORAGACEAE

Cat-tail, Coarse Water-milfoil

Life history**Growth form:** Perennial aquatic herb, rooting at the base; stems to 2 m long, 3–4 mm diam; leaves with feathery appearance.**Vegetative spread:****Longevity:** Indefinite.**Primary juvenile period:****Flowers:** Yellow to reddish, separate male and female flowers on same plant.**Fruit/seed:** Cylindrical, olive-brown, spiny, 1.5 mm long.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CT ST SWS SWP; Vic., S.A.**Distribution Sydney area:** Robertson.**Select locations:** CT: Wingecarribee Swamp (Orchard 1985).**Habitat****Habitat:** Lakes, backwaters of slowly moving watercourses.**Altitude:** 600 m**Annual rainfall:** 1600 mm**Typical local abundance:****Vegetation:****Substrate:****Exposure:****Conservation****Conservation:** Mainly occurs in Murray/Murrumbidgee drainage areas and in southern Victoria (Orchard 1985) with outlying population at Wingecarribee Swamp (Orchard 1985). Conservation status here unknown.***Myriophyllum crispatum***

HALORAGACEAE

Life history**Growth form:** Stout perennial aquatic herb with short rhizomes, rooting at nodes; leaves with feathery appearance. Stems stiffly erect 20–60 cm high, 3–5 mm diam., usually hairy (Orchard 1985).**Vegetative spread:** Stem fragments a major means of spread (Orchard 1985).**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** Male flowers cream–reddish brown or purple, separate male and female flowers on same plant, mainly October–April but some flowering at any time of year (Orchard 1985).**Fruit/seed:** Yellow-brown to deep red, prickly, cylindrical to 1 mm long. Main fruiting period October–April but some flowering at any time of year (Orchard 1985).**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:** Heavy insect predation of leaves and male flowers in late summer (Orchard 1985).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC NT CT ST NWS CWS SWS SWP; Qld, Vic., Tas., S.A., W.A.**Distribution Sydney area:** Western Sydney, Orange area.**Select locations:** CC: Parramatta, Emu Plains. CT: Mullions Range.

Habitat**Habitat:** Wetland, in still water or on mud, creeks.**Altitude:** 0–600 m **Annual rainfall:** 900–1000 mm**Typical local abundance:** Occasional.**Vegetation:** Aquatic vegetation.**Substrate:** Rarely found in deep water, usually in 5–50 cm stagnant water or on damp to saturated mud (Orchard 1985). Recorded on saline sites in western NSW (Semple 1993).**Exposure:****Conservation****Conservation:** Vulnerable in Western Sydney (Benson & McDougall 1991).***Myriophyllum gracile* var. *gracile*****HALORAGACEAE****Life history****Growth form:** Perennial aquatic herb with slender stems 10–30 cm high (Orchard 1985), rooting at nodes; leaves with feathery appearance.**Vegetative spread:** Spreads by rooting at nodes.**Longevity:****Primary juvenile period:****Flowers:** Male flowers creamy-yellow. Separate male and female flowers usually on same plant, September–April (Orchard 1985).**Fruit/seed:** Deep reddish brown, cylindrical to 0.7 mm long, mature September–April (Orchard 1985).**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC; Qld.**Distribution Sydney area:** Coastal.**Select locations:** CC: Port Jackson (1884), Royal NP (1893).**Habitat****Habitat:** Shallow water or on mud.**Altitude:** 0–200 m **Annual rainfall:** 1200 mm**Typical local abundance:****Vegetation:** With grasses if in mud (Orchard 1985).**Substrate:** In still, shallow water usually less than 30 cm deep, or on wet mud near water (Orchard 1985).**Exposure:****Conservation****Conservation:** Southern geographical limit is Sydney (Orchard 1985), but there have been no collections for 100 years, and it is possibly extinct in area.

Myriophyllum gracile* var. *lineare

HALORAGACEAE

Life history

Growth form: Perennial aquatic herb with slender stems to 20 cm high (Orchard 1985), rooting at nodes; leaves with feathery appearance.

Vegetative spread: Spreads by rooting at nodes.

Longevity: Indefinite.

Primary juvenile period:

Flowers: Male flowers creamy-yellow. Separate male and female flowers usually on same plant, August–March (Orchard 1985).

Fruit/seed: Deep reddish brown, cylindrical to 0.5 mm long, August–March (Orchard 1985).

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC CT CWS; Qld.

Distribution Sydney area: Sporadic.

Select locations: CC: Howes Swamp, Narrabeen, Centennial Park, Kensington, South Coogee, Alexandria Swamps (1883), Kogarah (1893). CT: Edina Falls (Hill Top).

Habitat

Habitat: Boggy situations, occasionally in shallow water.

Altitude: 0–700 m

Annual rainfall: 900–1200 mm

Typical local abundance: Occasional.

Vegetation: Sedgeland with e.g. *Philydrum lanuginosum*, *Juncus*, very localised.

Substrate: Wet sand or on sandstone. Usually in boggy situations or sometimes in shallow water, usually still, fresh, non-brackish (Orchard 1985). Fresh water to rarely saline.

Exposure:

Conservation

Conservation: Southern geographical limit is Hill Top.

Myriophyllum latifolium

HALORAGACEAE

Life history

Growth form: Robust, perennial aquatic herb with submerged stems to more than 1 m long, rooting at nodes; stems 3–3.5 mm diam; leaves with feathery appearance. Plants sterile where rarely found in terrestrial habitat (Orchard 1985).

Vegetative spread: Stem fragments possibly only means of spread (Orchard 1985).

Longevity:

Primary juvenile period:

Flowers: Separate male and female flowers usually on different plants, November–April.

Fruit/seed: Fruit unknown, even plants with male and female flowers not observed with fruit (Orchard 1985).

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC; Qld.

Distribution Sydney area: Sporadic.

Select locations: CC: West Wallsend (1961), Longneck Lagoon (Pitt Town 1969).

	Habitat
Habitat: Still water, more than 30 cm deep.	
Altitude: 0–100 m	Annual rainfall: 800–1200 mm
Typical local abundance:	
Vegetation: Freshwater sedgeland e.g. with <i>Elaecharis sphacelata</i> , <i>Myriophyllum aquaticum</i> .	
Substrate: Still water 30–200 cm deep, and on mud, rarely in terrestrial habitat (Orchard 1985).	
Exposure:	
	Conservation
Conservation: Not recorded recently at Longneck Lagoon, its southern geographical limit. Status at West Wallsend unknown.	

Myriophyllum pedunculatum subsp. *longibracteolatum* HALORAGACEAE

	Life history
Growth form: Perennial aquatic herb with feathery leaves.	
Vegetative spread: Mat-forming, rooting at nodes.	
Longevity: Indefinite.	
Primary juvenile period:	
Flowers: Separate male and female flowers on same plant, November–March.	
Fruit/seed: Reddish purple to black, 1–1.5 mm long, November–March.	
Dispersal, establishment & growth:	
Fire response:	
Interaction with other organisms:	
	Distribution
Status/origin: Native.	
Botanical subregions: NC SC CT; Vic., Tas.	
Distribution Sydney area: Upper Blue Mountains.	
Select locations: CT: Katoomba (1959), Mt Wilson (1902).	
	Habitat
Habitat: Creeks.	
Altitude: 900–1000 m	Annual rainfall: 1200–1400 mm
Typical local abundance:	
Vegetation: Heathland.	
Substrate: On sandstone, low nutrients.	
Exposure:	
	Conservation
Conservation: Appears to be rare in Sydney area.	

Myriophyllum pedunculatum* subsp. *pedunculatum

HALORAGACEAE

Life history**Growth form:** Perennial aquatic herb with robust stems and feathery leaves.**Vegetative spread:** Mat-forming, rooting at nodes.**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** Separate male and female flowers on same plant, November–February.**Fruit/seed:** Reddish purple to black, 1–1.5 mm long, November–February.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NT CT ST; Vic., Tas., N.G.**Distribution Sydney area:** Upper Blue Mountains and Southern Highlands.**Select locations:** CT: Wentworth Falls, Mt Wilson, Clarence, Boyd Plateau, Braemar, Wingecarribee Swamp, Belmore Falls, Carrington Falls.**Habitat****Habitat:** High altitude creekbanks and swamps.**Altitude:** 600–1100 m**Annual rainfall:** 900–1600 mm**Typical local abundance:** Frequent.**Vegetation:** Moist open-heath/sedgeswamp, *Sphagnum* swamp and creekbanks.**Substrate:** Moist sand or peaty sand over sandstone, peat, low nutrients.**Exposure:****Conservation****Conservation:*****Myriophyllum simulans***

HALORAGACEAE

Life history**Growth form:** Perennial aquatic herb; stems 1–2 mm diam.**Vegetative spread:** Fragments root at nodes.**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** Male flowers reddish, separate male and female flowers on same plant, November.**Fruit/seed:** Deep reddish purple. Stranding or growth in a terrestrial environment from the beginning is necessary to stimulate or ensure good seed set (Orchard 1985).**Dispersal, establishment & growth:** Diaspore: fruit.**Fire response:****Interaction with other organisms:** Foodplant of Black Swan *Cygnus atratus* (Barker & Vestjens 1989,1990).**Distribution****Status/origin:** Native.**Botanical subregions:** CC SC NT CT ST NWP SFWP; Qld, Vic., Tas., S.A.**Distribution Sydney area:** Widespread.**Select locations:** CC: Richmond, Leumeah, Centennial Park (1908), Kogarah (1893), Berry. CT: Wingecarribee Swamp.**Habitat****Habitat:** Still water or mud.**Altitude:** 0–700 m**Annual rainfall:** 800–1600 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Low open-forest of *Melaleuca*, or sedgeland e.g. with *Ranunculus inundatus*, *Eleocharis sphacelata*, *Triglochin procera*, *Lycopus australis*.**Substrate:** Deep water (30–50 cm deep) to damp mud on shale, peat.**Exposure:****Conservation****Conservation:**

Myriophyllum variifolium

HALORAGACEAE

Life history

Growth form: Perennial aquatic herb; stems to 5 mm diam.
Vegetative spread: Stem fragments a major means of spread (Orchard 1985).
Longevity: Indefinite.
Primary juvenile period:
Flowers: Separate male and female flowers on same plant, September–May, peak December–February.
Fruit/seed: Yellowish-brown to pale reddish 1.5 mm long.
Dispersal, establishment & growth:
Fire response:
Interaction with other organisms: Foodplant of Black Swan *Cygnus atratus* (Barker & Vestjens 1989,1990). Heavy insect predation (small black beetles, ?*Haltica ignea*) of emergent parts in late summer (Orchard 1985).

Distribution

Status/origin: Native.
Botanical subregions: NC CC SC NT CT ST CWS; Vic., Tas., S.A.
Distribution Sydney area: Coast and Southern Highlands.
Select locations: CC: Kensington, Audley, Liverpool, Mulgoa, Menangle, Glenbrook, Thirlmere Lakes, Yerranderie. CT: Bowral, Paddys River.

Habitat

Habitat: Riverbanks, creeks.
Altitude: 0–600 m **Annual rainfall:** 800–1200 mm
Typical local abundance: Frequent.
Vegetation: Freshwater wetland e.g. with *Potamogeton*, *Lepironia articulata*, *Brasenia schreberi*, *Utricularia exoleta*, *Eleocharis sphacelata*, *Ottelia ovalifolia*.
Substrate: Still or slowly flowing water, 30 cm to 2 m deep, and on drying mud.
Exposure:

Conservation

Conservation: Vulnerable in Western Sydney (Benson & McDougall 1991).

Myriophyllum verrucosum

HALORAGACEAE

Red Water-milfoil

Life history**Growth form:** Perennial aquatic herb; stems to 1.5 mm diam.**Vegetative spread:** Roots at nodes.**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** Male flowers yellow, separate male and female flowers on same plant, sometimes with a few bisexual flowers. Flowers at any time of year. Flowering appears to be triggered by falling water levels (Orchard 1985).**Fruit/seed:** Yellowish, red or grey, ridged and warty, 1 mm long. Fruit at any time of year.**Dispersal, establishment & growth:** Diaspore: fruit. Plants that germinate on, or are stranded on damp mud grow to 10 cm high and flower and fruit profusely. Plants in deep water in fast flowing rivers produce submerged stems but never flower.**Fire response:****Interaction with other organisms:** Foodplant of Black Swan *Cygnus atratus* (Barker & Vestjens 1989,1990), also eaten by ducks and stock (Orchard 1985).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., N.T., S.A., W.A.**Distribution Sydney area:** Widespread.**Select locations:** CC: Penrith, Shellharbour, Yerranderie, Kowmung River.

CT: Wattle Flat, Sofala, Cudgegong River.

Habitat**Habitat:** Various, riverbanks, wetlands.**Altitude:** 0–1000 m**Annual rainfall:** 600–1200 mm**Typical local abundance:** Rare–occasional.**Vegetation:** Instream vegetation e.g. with *Ranunculus*, *Potamogeton*, *Casuarina cunninghamiana*.**Substrate:** Water 30–60 cm deep, stagnant or slow flowing among stones in swift flowing water; peaty soil on wetland margins.**Exposure:****Conservation****Conservation:*****Phacelia tanacetifolia* ***

HYDROPHYLLACEAE

Life history**Growth form:** Hairy herb 20–80 cm high.**Vegetative spread:** No.**Longevity:** 1 year.**Primary juvenile period:** Less than 1 year.**Flowers:** Blue, September–November.**Fruit/seed:** Capsule 3–4 mm long, usually with 2 greyish brown seeds.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to N America. Possibly imported in American hay at Richmond (Herb. note).**Botanical subregions:** CC CT CWS SWS.**Distribution Sydney area:****Select locations:** CC: Richmond (1916). CT: Hill Top (1912).

		Habitat
Habitat:		
Altitude: 0–700 m	Annual rainfall: 800–900 mm	
Typical local abundance:		
Vegetation:		
Substrate:		
Exposure:		
		Conservation
Conservation: Uncommon garden escape showing no evidence of invasion into bushland.		

Citronella moorei

ICACINACEAE

Churnwood

Life history

Growth form: Large tree to 40 m high
Vegetative spread: No (A. Bofeldt pers. comm.).
Longevity: Very long-lived (A. Bofeldt pers. comm.).
Primary juvenile period:
Flowers: White, male and female flowers on separate plants, May–September.
Fruit/seed: Black fleshy fruit 15–22 mm long with one seed; 1120 seeds/kg.
 Mature December–June.
Dispersal, establishment & growth: Diaspore: fruit, bird-dispersed, germination slow, taking from 6 months to 14 months (Floyd 1989, A. Bofeldt pers. comm.).
Fire response: Possibly killed (A. Bofeldt pers. comm.).
Interaction with other organisms: Fruit eaten by Green Catbird, Topknot Pigeon and Wompoo Fruit-dove (Floyd 1989). Hollow pipe of living tree roost site for Southern Boobook Owl (A. Bofeldt & M. Robinson pers. comm.).

Distribution

Status/origin: Native.
Botanical subregions: NC CC SC; Qld.
Distribution Sydney area: Coast, Gosford, Illawarra.
Select locations: CC: Matcham, Bola Creek, Albion Park, Minnamurra Falls, Foxground.

Habitat

Habitat: Moist sheltered gullies and slopes. Escarpment bench (A. Bofeldt & M. Robinson pers. comm.).

Altitude: 0–450 m **Annual rainfall:** 1200–1600 mm
Typical local abundance: Occasional.

Vegetation: Subtropical and warm temperate rainforest e.g. with *Ceratopetalum apetalum*, *Cryptocarya glaucescens*, *Doryphora sassafras*, *Guioia semiglauc*, *Synoum glandulosum*.
Substrate: Clay soil on shale, basalt, alluvium, high nutrients, well-drained. Coal Measures, Budgong Sandstone, Bumbo Latite Member in Illawarra (A. Bofeldt & M. Robinson pers. comm.).
Exposure: Full shade (A. Bofeldt & M. Robinson pers. comm.).

Conservation

Conservation: Reported from Macquarie Pass NP, Budderoo NP and Illawarra (A. Bofeldt & M. Robinson pers. comm.), but conservation status unknown.

Pennantia cunninghamii

ICACINACEAE

Brown Beech

Life history**Growth form:** Tree to 25 m high.**Vegetative spread:** No (M. Robinson pers. comm.)**Longevity:** Long-lived (M. Robinson pers. comm.).**Primary juvenile period:****Flowers:** White, bisexual or unisexual, plants either with bisexual or male flowers, November–January.**Fruit/seed:** Black egg-shaped fleshy fruit 10–15 mm long, 180 seeds/kg, mature October–July.**Dispersal, establishment & growth:** Diaspore: fleshy fruit, bird-dispersed. Germination of fresh seeds takes 6–25 days (Floyd 1989), short viability, germination 3–8 weeks (A. Bofeldt pers. comm.).**Fire response:** Possibly killed (A. Bofeldt pers. comm.).**Interaction with other organisms:** Fruit eaten by Brown Cuckoo-dove, Green Catbird, Topknot Pidgeon, Wompoo Fruit-dove and White-headed Pigeon (Floyd 1989). Fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995). Moth larva *Cardamyla carinentalis* forms shelter between leaves where it pupates (Common 1990).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT ST CWS; Qld.**Distribution Sydney area:** Coastal ranges.**Select locations:** CC: Mt Warrawolong, Mt Keira, Bulli, Gerringong, Kiama, Cambewarra. CT: Robertson, Belmore Falls.**Habitat****Habitat:** Rocky gullies near watercourses, hilltops.**Altitude:** 0–750 m**Annual rainfall:** 1200–1600 mm**Typical local abundance:** Occasional to frequent.**Vegetation:** Subtropical and warm temperate rainforest e.g. with *Doryphora sassafras*, *Ceratopetalum apetalum*, *Acmena smithii*, *Cissus antarctica*.**Substrate:** Rocky hillsides on basalt, sandstone and along watercourses, medium to high nutrients, high soil moisture. Coal Measures, Alluvium, Budgong Sandstone, Narrabeen Series in Illawarra (A. Bofeldt & M. Robinson pers. comm.).**Exposure:** Full shade.**Conservation****Conservation:** Not known. Habitat poorly conserved in Illawarra, reported from Macquaries Pass NP, Budderoo NP (A. Bofeldt & M. Robinson pers. comm.).***Ajuga australis***

LAMIACEAE

Austral Bugle

Life history**Growth form:** Perennial herb with rosette leaves. A variable taxon probably containing 2 or 3 distinct species (Harden 1992).**Vegetative spread:** No (McIntyre et al. 1995).**Longevity:** Short-lived, c. 2–3 years (L.McD.)**Primary juvenile period:****Flowers:** Violet to blue, throughout year, peak September–November.**Fruit/seed:** Dry fruit, November.**Dispersal, establishment & growth:** Mechanism for dispersal undefined (McIntyre et al. 1995). Erect flowering stems become horizontal at maturity allowing short distance gravity-dispersal of seed (L.McD.)**Fire response:****Interaction with other organisms:** Grazed by rabbits.

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP;
Qld, Vic., Tas., S.A.

Distribution Sydney area: Widespread.

Select locations: CC: Mt Yengo, Kurrajong, Richmond, St Marys, Campbelltown, Nortons Basin, Razorback. CT: Yerranderie, Jenolan Caves, Lewis Ponds, Mt Werong, Taralga, Sutton Forest.

Habitat

Habitat: Woodland on clay soils.

Altitude: 0–800 m **Annual rainfall:** 600–1000 mm

Typical local abundance: Frequent–occasional.

Vegetation: Grassy woodland e.g. with *Eucalyptus crebra*, *E. tereticornis*, *E. moluccana*, *Themeda australis* or open-forest e.g. with *Eucalyptus stellulata*, *E. pauciflora*.

Substrate: Clay soils on Wianamatta Shale, basalt, alluvial quartzite, medium to high nutrients, well-drained.

Exposure: Full sun to light shade.

Conservation

Conservation: Vulnerable in Western Sydney (Benson & McDougall 1991).

Hemigenia cuneifolia

LAMIACEAE

Life history

Growth form: Shrub to 2.5 m high, with leaves in whorls of 3.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Blue–mauve, September–February, peak November.

Fruit/seed: Dry fruit.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC NC NWS CWS; Qld.

Distribution Sydney area: Mainly Woronora Plateau.

Select locations: CC: Upper Colo, Lane Cove (1885), Glenfield, Tahmoor. CT: Hilltop, Tallowa Dam.

Habitat

Habitat: Rocky slopes.

Altitude: 0–600 m **Annual rainfall:** 800–1000 mm

Typical local abundance: Frequent–occasional.

Vegetation: Eucalypt open-forest e.g. with stringybarks, *Dodonaea triquetra*, *Lasiopetalum ferrugineum*, *Pultenaea blakelyi*.

Substrate: Sandy soil over sandstone, low nutrients, well-drained.

Exposure:

Conservation

Conservation: Not known.

Hemigenia purpurea

LAMIACEAE

Life history

Growth form: Shrub 0.1–2 m**Vegetative spread:****Longevity:****Primary juvenile period:** 2 years (Benson 1985).**Flowers:** Blue, August–April, peak September–January. Flowers visited by two species of native bee, probably for nectar; probably pollinated by native bees (P. Kubiak pers. comm.).**Fruit/seed:** Dry fruit**Dispersal, establishment & growth:** Diaspore: fruit with ant-adapted food body for dispersal (Westoby et al. 1990).**Fire response:** Killed by high intensity fire (1/94) at Narrabeen, peak flowering 3 years after high intensity fire (1/94) at Lane Cove, but some plants with green fruit in 2 years (P. Kubiak pers. comm.).**Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** CC SC CT.**Distribution Sydney area:** Coastal plateaus and Blue Mountains.**Select locations:** CC: Norah Heaad, Somersby, Woy Woy, Maroota, West Head, Balgowlah, Long Bay, Cronulla, Wattamolla. CT: Deadmans Creek, Woodford, Mt Boonbourwa.

Habitat

Habitat: Coastal and mountain heath.**Altitude:** 0–800 m**Annual rainfall:** 1000–1400 mm**Typical local abundance:** Frequent.**Vegetation:** Woodland e.g. with *Corymbia gummifera*, *Angophora hispida*, *Eucalyptus laenastoma*; heath e.g. with *Banksia ericifolia*, *Allocasuarina nana*, *Acacia suaveolens*, *Isopogon anemonifolius*.**Substrate:** Sandy soil on sandstone, low nutrients.**Exposure:** Full sun to light shade.

Conservation

Conservation: Widespread and probably adequately conserved.*Lamium amplexicaule* *

LAMIACEAE

Dead Nettle

Life history

Growth form: Hairy herb to 40 cm high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Pale pink to rose-coloured, April–November.**Fruit/seed:** Dry fruit**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:** Can cause 'staggers' if eaten by stock (Harden 1992).

Distribution

Status/origin: Exotic, probably native to Europe, W Asia, Africa.**Botanical subregions:** NC CC NT CT ST NWS CWS SWS NWP; Qld, Vic., Tas., S.A., W.A., N.Z.**Distribution Sydney area:** Western Sydney, Bathurst–Orange.**Select locations:** CC: Cooranbong, Wondabyne, Richmond (1963), Flemington, Liverpool, Albion Park. CT: Bathurst, Orange.

	Habitat
Habitat: Wasteland, saleyards.	
Altitude: 0–1000 m	Annual rainfall: 600–1100 mm
Typical local abundance: Occasional.	
Vegetation: Associated with garden weeds.	
Substrate: Clay soils on shale, medium nutrients.	
Exposure:	
	Conservation
Conservation: Widespread weed, especially of crops and disturbed sites.	

<i>Lavandula stoechas</i> *	LAMIACEAE
Topped Lavender	
	Life history
Growth form: Shrub to 80 cm high, covered with greyish, woolly hairs.	
Vegetative spread: No.	
Longevity:	
Primary juvenile period:	
Flowers: Deep bluish purple, September–January.	
Fruit/seed: Dry fruit.	
Dispersal, establishment & growth:	
Fire response:	
Interaction with other organisms: Seed eaten by Crimson Rosella <i>Platycercus elegans</i> (Lepschi 1993).	
	Distribution
Status/origin: Exotic, native to Mediterranean region and NE Africa.	
Botanical subregions: CC SC SWS; Qld, Vic., S.A., W.A.	
Distribution Sydney area: Sporadic	
Select locations: CC: Balgowlah (1949), Goodmans Ford (1985).	
	Habitat
Habitat: Roadside.	
Altitude: 0–300 m	Annual rainfall: ~1200 mm
Typical local abundance: Frequent.	
Vegetation:	
Substrate:	
Exposure:	
	Conservation
Conservation: Occasionally naturalised garden escape.	

***Leonotis leonurus* ***

LAMIACEAE

Lion's Tail

Life history**Growth form:** Perennial, hairy shrub to 2 m high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Bright orange, June–October.**Fruit/seed:** Dry fruit.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to S Africa.**Botanical subregions:** ?NC CC SC.**Distribution Sydney area:****Select locations:** CC: Manly, La Perouse (1975), Shoalhaven Heads.**Habitat****Habitat:****Altitude:** 0–50 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Coastal heath and scrub.**Substrate:** Coastal sand, low nutrients, well-drained.**Exposure:****Conservation****Conservation:** Garden escape in coastal areas south from Sydney (Harden 1992).***Lycopus australis***

LAMIACEAE

Australian Gipsywort

Life history**Growth form:** Perennial herb to 1 m high, with branches arising from rhizome.**Vegetative spread:** Rhizomatous spread to form local patches.**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** White, January–February.**Fruit/seed:** Dry fruit, January–February.**Dispersal, establishment & growth:** Dies back in winter from frost and dryness, and regrows from rhizomes.**Fire response:****Interaction with other organisms:** Not touched by stock (Herb. note 1952).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT ST CWS SWS; Qld, Vic., Tas., S.A.**Distribution Sydney area:** Coast and occasionally Tablelands.**Select locations:** CC: Wisemans Ferry, Longneck Lagoon, Richmond, Peats Bight, Liverpool, Shoalhaven Heads. CT: Moss Vale, Jenolan Caves, Wingecarribee Swamp.**Habitat****Habitat:** Damp ground on edge of fresh swamps, roadsides, shaded sites; upland peatland swamps (P. Kodela pers. comm.).**Altitude:** 0–700 m**Annual rainfall:** 700–1200 mm**Typical local abundance:** Frequent.**Vegetation:** Sedgeland e.g. with *Blechnum indicum*, *Carex* spp., *Phragmites australis*, *Eleocharis sphacelata*; woodland e.g. with *Casuarina glauca*, or *Leptospermum obovatum*, *Geranium neglectum*.**Substrate:** Sandy alluvial deposits, peat (P. Kodela pers. comm.), low–medium nutrients.**Drainage impeded.****Exposure:****Conservation****Conservation:** Vulnerable in Western Sydney (Benson & McDougall 1991).

***Marrubium vulgare* ***

LAMIACEAE

Horehound

Life history

Growth form: Perennial shrub to 60 cm high, with covering of greyish to white stellate hairs on leaves and branches.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: White, August-January.

Fruit/seed: 4-seeded burr-like dry segmented fruit enclosed within calyx crowned with hooked teeth (Clemson 1985).

Dispersal, establishment & growth: Diaspore: burr, animal-dispersed by attachment (Felfoldi 1993).

Fire response:

Interaction with other organisms: Food plant of Stubble Quail *Coturnix pectoralis* (Barker & Vestjens 1989, 1990). Pollen attractive to bees, a good source of light-coloured honey (Clemson 1985). Leaves used in manufacture of cough mixtures, and herbal beer made from plant extracts (Felfoldi 1993).

Distribution

Status/origin: Exotic, native to Europe & N Africa.

Botanical subregions: NC CC SC NT CT ST CWS SWS; Qld, Vic., Tas., S.A.

Distribution Sydney area: Widespread.

Select locations: CC: Pennant Hills, Flemington, Leumeah, Campbelltown, Lake Illawarra. CT: Kandos, Wattle Flat, Bathurst, Bundanoon (1897).

Habitat

Habitat: Disturbed sites, roadsides, farms, waste areas.

Altitude: 0–1000 m **Annual rainfall:** 600–1400 mm

Typical local abundance: Frequent.

Vegetation: Grassland; remnant open-forest e.g. with *Corymbia maculata*, *Eucalyptus tereticornis* (M. Robinson pers. comm.).

Substrate: Clay soils on shale, basalt, sheep or cattle camps, medium to high nutrients. Recorded on saline sites in western NSW (Semple 1993).

Exposure:

Conservation

Conservation: Weed of waste places.

***Melissa officinalis* subsp. *officinalis* ***

LAMIACEAE

Balm

Life history**Growth form:** Herb to 1 m high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Pale yellow to pinkish blue, December–March.**Fruit/seed:** Dry fruit.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to E Mediterranean, widely naturalised in Europe.**Botanical subregions:** CT ST; Vic., Tas., S.A.**Distribution Sydney area:** Orange.**Select locations:** CT: Orange (1982) only record.**Habitat****Habitat:** Along creeks and drainage lines.**Altitude:** 800 m**Annual rainfall:** 100 mm**Typical local abundance:****Vegetation:****Substrate:** Moist areas.**Exposure:****Conservation****Conservation:** Rarely naturalised, though often growing vigorously in gardens.***Mentha diemenica***

LAMIACEAE

Slender Mint

Life history**Growth form:** Mat-forming herb with ascending to prostrate branches. The *Mentha saturioides* group (*M. saturioides* and *M. diemenica*) represent the extreme of what appears to be a morphological continuum. Many populations show a range of intermediates (Harden 1992).**Vegetative spread:** Yes (McIntyre et al. 1995), forms mats by rhizomatous spread.**Longevity:****Primary juvenile period:****Flowers:** Purple, often pale, at any time of year, peak November–June.**Fruit/seed:** Dry fruit.**Dispersal, establishment & growth:** No particular morphology for dispersal (McIntyre et al. 1995).**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC NT CT ST NWS CWS SWS NWP SWP SFWP; Qld, Vic. Tas., S.A., N.T.**Distribution Sydney area:** Widespread.**Select locations:** CC: Grose Vale, Richmond, Hornsby, Kogarah (1897), Springwood, Campbelltown, Capertee. CT: Mt Victoria, Hartley, Lidsdale, Hargreaves, Bathurst, Blayney.**Habitat****Habitat:** Creekbanks, hillsides on clay soils.**Altitude:** 0–1000 m**Annual rainfall:** 600–1400 mm**Typical local abundance:** Frequent to occasional.**Vegetation:** Eucalypt tall open-forest e.g. with *Eucalyptus fastigata*, *E. blaxlandii*, *Lomandra longifolia*, *Stellaria pungens*, *Tylophora barbata*; eucalypt woodland e.g. with *Eucalyptus crebra*, and *Themeda australis* grassland.**Substrate:** Loamy soil from shale, basalt, limestone, medium nutrients.**Exposure:** Full sun to mid shade.**Conservation****Conservation:** Conservation status unknown.

<i>Mentha laxiflora</i>	LAMIACEAE
Forest Mint	
	Life history
Growth form: Hairy, procumbent herb to 60 cm high, rooting from nodes of stems.	
Vegetative spread: Stoloniferous.	
Longevity:	
Primary juvenile period:	
Flowers: White, pink, pale blue-mauve to mauve, January–July.	
Fruit/seed: Dry fruit.	
Dispersal, establishment & growth:	
Fire response:	
Interaction with other organisms:	
	Distribution
Status/origin: Native.	
Botanical subregions: CC CT ST NWP SEWP; Qld, Vic.	
Distribution Sydney area: Blue Mountains.	
Select locations: CC: Euroka. CT: Lidsdale, Tuglow Caves.	
	Habitat
Habitat: Damp or swampy areas near rivers and creeks.	
Altitude: 0–1000 m Annual rainfall: 800–900 mm	
Typical local abundance: Rare.	
Vegetation: Grassland.	
Substrate: Clay soils on volcanics, limestone, medium nutrients.	
Exposure: Mid shade.	
	Conservation
Conservation: Few collections and apparently rare. Conservation status unknown.	

<i>Mentha pulegium</i> *	LAMIACEAE
Pennyroyal	
	Life history
Growth form: Herb to 40 cm high, stoloniferous and rooting at nodes.	
Vegetative spread: Spreads by stolon, rooting at nodes.	
Longevity: Indefinite.	
Primary juvenile period:	
Flowers: Pale mauve to lilac, January–April.	
Fruit/seed: Dry fruit.	
Dispersal, establishment & growth:	
Fire response:	
Interaction with other organisms:	
	Distribution
Status/origin: Exotic.	
Botanical subregions: CC SC NT ST CWS SWS SWP; Qld, Vic., Tas., S.A.	
Distribution Sydney area: Sydney suburbs.	
Select locations: CC: Epping, Carlingford, Gordon (1916), Burwood (1913).	
	Habitat
Habitat:	
Altitude: 0–300 m Annual rainfall: 900–1400 mm	
Typical local abundance: Frequent.	
Vegetation: Reported from bushland.	
Substrate: Sandy to loamy soil on Wianamatta Shale, medium nutrients.	
Exposure:	
	Conservation
Conservation: Reported from bushland at Carlingford but potential for spread unknown.	

Mentha satureioides

LAMIACEAE

Creeping Mint, Native Pennyroyal

Life history**Growth form:** Mat-forming herb with ascending to prostrate branches at nodes.The *Mentha saturioides* group (*M. saturioides* and *M. diemenica*) represent the extreme of what appears to be a morphological continuum. Many populations show a range of intermediates (Harden 1992).**Vegetative spread:** Spreading by rhizome perhaps up to 1 m.**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** White or pink, at any time of year, peak November–March.**Fruit/seed:** Dry fruit, mature December.**Dispersal, establishment & growth:** Diaspore: seed, no particular morphology for dispersal (McIntyre et al. 1995).**Fire response:** Probably resprouts from rhizome.**Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWP; Qld, Vic., S.A.**Distribution Sydney area:** Mainly western Sydney.**Select locations:** CC: Duck River, Prospect, Cambelltown, Camden, Razorback.

CT: Capertee Valley.

Habitat**Habitat:** Hillside.**Altitude:** 0–600 m**Annual rainfall:** 700–1200 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Eucalypt open-forest e.g. with *Eucalyptus eugenioides*, *E. fibrosa*, *Melaleuca nodosa*, *M. decora*; woodland e.g. with *Corymbia maculata*, *Bursaria spinosa*; and grassland.**Substrate:** Clay soil on Wianamatta Shale, medium nutrients.**Exposure:** Full sun to light shade.**Conservation****Conservation:** Vulnerable in Western Sydney (Benson & McDougall 1991).***Mentha* X *piperita* nothomorph *citrata* ***

LAMIACEAE

Lemon Mint, Eau-de-Cologne Mint

Life history**Growth form:** Aromatic herb to 80 cm high, rhizomatous or stoloniferous, branches often tinged purple and youngest leaves often with a red margin. Leaves with odour of 'Eau-de-Cologne'. A variant of the hybrid *Mentha* X *piperita*, known as a nothomorph.**Vegetative spread:** Rhizomatous or stoloniferous.**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** Lilac to pink, globular clusters, April.**Fruit/seed:** Fruit not developed.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to Europe.**Botanical subregions:** NC CC ST SWS.**Distribution Sydney area:** Sporadic.**Select locations:** CC: Forestville Park (L.McD.), Killara (1920), Ashfield (1921), Menangle, Cambewarra Mountain. CT: Lyndhurst.

	Habitat
Habitat: Silted creeks, roadsides.	
Altitude: 0–800 m	Annual rainfall: 800–1400 mm
Typical local abundance:	
Vegetation: With creekbank weeds e.g. <i>Conyza</i> *, <i>Verbena</i> *.	
Substrate: Very moist, alluvium, medium to high nutrients (pH 9 recorded in creek sediment at Forestville L.McD.).	
Exposure:	
	Conservation
Conservation: Locally naturalised in moist sites. Unlikely to invade bushland.	

<i>Mentha</i> × <i>piperita</i> nothomorph <i>piperita</i> *	LAMIACEAE
Peppermint	
	Life history
Growth form: Aromatic herb to 80 cm high, rhizomatous or stoloniferous, branches often tinged purple. Leaves with pungent odour of peppermint. A variant of the hybrid <i>Mentha</i> × <i>piperita</i> , known as a nothomorph.	
Vegetative spread: Rhizomatous or stoloniferous.	
Longevity: Indefinite.	
Primary juvenile period:	
Flowers: Lilac to pink, cylindrical, April.	
Fruit/seed: Fruit not developed.	
Dispersal, establishment & growth:	
Fire response:	
Interaction with other organisms:	
	Distribution
Status/origin: Exotic, native to Europe.	
Botanical subregions: NC CC ST SWS.	
Distribution Sydney area: Sporadic.	
Select locations: CC: Capertee Valley (1965), Cambewarra (1923).	
	Habitat
Habitat: Creeks.	
Altitude: 0–600 m	Annual rainfall: 600–1400 mm
Typical local abundance:	
Vegetation: Woodland e.g. <i>Eucalyptus melliodora</i> , <i>Angophora floribunda</i> .	
Substrate: Alluvial soil along creeks.	
Exposure:	
	Conservation
Conservation: Locally naturalised in moist sites. Uncommon and unlikely to invade bushland.	

***Mentha X spicata* ***

LAMIACEAE

Spearmint

Life history

Growth form: Herb to 1 m high, rhizomatous, often rooting at nodes. A fertile hybrid, sometimes given species status (Harden 1992).

Vegetative spread: Rhizomatous.

Longevity: Indefinite.

Primary juvenile period:

Flowers: Lilac, pink or white, mostly January–March.

Fruit/seed:

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, origin unknown, widely cultivated and naturalised throughout Europe.

Botanical subregions: NC CC CT NT CT ST NWS CWS; Vic., Tas., S.A., W.A.

Distribution Sydney area: Widespread.

Select locations: CC: Cheltenham (1951), Balgowlah (1954), Ashfield (1921), Strathfield (1949), Kangaroo Valley. CT: Blackheath (1954), Moss Vale, Lithgow.

Habitat

Habitat: Damp areas of drains and creeks, ditches, riverbanks.

Altitude: 0–1000 m **Annual rainfall:** 1000–1600 mm

Typical local abundance: Frequent.

Vegetation: Herb undergrowth in woodland e.g. *Eucalyptus fastigata*, *E. cypellocarpa*.

Substrate: Clay soils on shale, alluvium, moderate nutrients.

Exposure:

Conservation

Conservation: Introduced as horticultural plant. Not invasive of bushland.

***Moluccella laevis* ***

LAMIACEAE

Molucca Balm

Life history

Growth form: Annual herb to 70 cm high.

Vegetative spread: No.

Longevity: 1 year.

Primary juvenile period:

Flowers: White to pink with mauve markings, September–April.

Fruit/seed: Dry fruit often dispersed still enclosed in calyx.

Dispersal, establishment & growth: Diaspore: fruit, frequently grows in disturbed areas.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to NE Mediterranean and Caucasus.

Botanical subregions: CC NT NWS CWS NWP NFWP; Vic., S.A., W.A.

Distribution Sydney area:

Select locations: CC: Gladesville (1913).

Habitat

Habitat: Disturbed areas.

Altitude: 0–200 m **Annual rainfall:** 1000–1200 mm

Typical local abundance:

Vegetation:

Substrate: Clay soils on shale, medium nutrients.

Exposure:

Conservation

Conservation: Garden escape, unlikely to invade bushland areas.

Orthosiphon aristatus

LAMIACEAE

Life history

Growth form: Slender herb 20–50 cm high.
Vegetative spread:
Longevity:
Primary juvenile period:
Flowers: White, pale lilac or lilac, April and October.
Fruit/seed: Dry fruit.
Dispersal, establishment & growth:
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: CC; Qld, Malesia.
Distribution Sydney area: Mainly in Gosford district, possibly introduced (Harden 1992).
Select locations: CC: Mt Katandra Recreation Reserve (1987), Heathcote (1993).

Habitat

Habitat: Gaps in rainforest, steep creekbank.
Altitude: 0–200 m **Annual rainfall:** 1200–1400 mm
Typical local abundance: Rainforest gully e.g. with *Ceratopetalum apetalum* or creekbank e.g. with *Gahnia* sp. and weeds *Ageratina adenophora**, *Pennisetum clandestinum**.
Vegetation:
Substrate: Yellow podsolic soils on Narrabeen Group.
Exposure:

Conservation

Conservation: Native to Queensland, possibly introduced to Gosford district (Harden 1992), spreading rapidly at Mt Katandra (R. Payne, Herb. note) and recently recorded at Heathcote (1993).

Plectranthus ciliatus *

LAMIACEAE

Life history

Growth form: Pleasantly aromatic, soft, perennial, straggling succulent herb or subshrub to 60 cm high, with fleshy leaves.
Vegetative spread:
Longevity:
Primary juvenile period:
Flowers: Whitish, at any time of year.
Fruit/seed: Dry fruit enclosed in calyx, 8–10 mm long at maturity.
Dispersal, establishment & growth:
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Exotic, native to SE Africa.
Botanical subregions: CC; Vic.
Distribution Sydney area: Northbridge.
Select locations: CC: Northbridge (1972).

Habitat

Habitat:
Altitude: 0–100 m **Annual rainfall:** 1200 mm
Typical local abundance:
Vegetation: Naturalised in native vegetation.
Substrate: Moist sandy soils from sandstone.
Exposure:

Conservation

Conservation: Frequently cultivated and locally naturalised at Northbridge.
Potential for spread unknown.

Plectranthus graveolens

LAMIACEAE

Life history

Growth form: Strongly, slightly unpleasant aromatic, hairy shrub to 1 m high.

Distinction between *P. graveolens* and some plants of *P. suaveolens* and *P. parviflorus* is unclear as these taxa appear to intergrade (Harden 1992).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Violet-blue, at any time of year.

Fruit/seed: Dry fruit enclosed in calyx, 4–5 mm long at maturity.

Dispersal, establishment & growth: Germination after mechanical disturbance (A. Bofeldt & M. Robinson pers. comm.).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC ?CC SC NT ?CT; LHI, Qld.

Distribution Sydney area:

Select locations: CC: Peats Ferry (Hawkesbury River, 1887). CT: Mt Colong, Mittagong, Wombeyan.

Habitat

Habitat: Rocky crevices and ledges.

Altitude: 0–1000 m

Annual rainfall: 1000–1100 mm

Typical local abundance:

Vegetation: Dry rainforest and open-forest ecotone e.g. with *Melaleuca armillaris* (A. Bofeldt & M. Robinson pers. comm.).

Substrate: Basalt, medium nutrients.

Exposure: Exposed.

Conservation

Conservation: Conservation status unknown.

Plectranthus neochilus *

LAMIACEAE

Life history

Growth form: Unpleasantly aromatic herb 12–50 cm high, with succulent, hairy branches.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Mauve-purple, rarely whitish, at any time of year.

Fruit/seed: Dry fruit enclosed in calyx, to 6 mm long at maturity.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to southern Africa.

Botanical subregions: ?CC.

Distribution Sydney area: Castlecrag (only record).

Select locations: CC: Castlecrag (1959).

Habitat

Habitat: Damp place in disturbed ground (Castlecrag).

Altitude: 0–100 m

Annual rainfall: 1200 mm

Typical local abundance: Frequent.

Vegetation:

Substrate:

Exposure:

Conservation

Conservation: Garden plant, one record for Sydney area (at Castlecrag) and probably localised garden escape. Doubtfully naturalised in the Sydney district (Harden 1992).

Plectranthus parviflorus

LAMIACEAE

Life history

Growth form: Shrub to 10–70 cm high with fleshy tuberous base. Variable species difficult to distinguish from *P. graveolens* and *P. suaveolens* (Harden 1992).

Vegetative spread: Possibly some spread by rooting along stems.

Longevity: 2–5 years.

Primary juvenile period: Less than 1 year.

Flowers: Pale blue to violet-blue, September–July, peak December, March. Branches die after flowering (Harden 1992).

Fruit/seed: Dry fruit enclosed in calyx, 4–5 mm long. Mature November–June.

Dispersal, establishment & growth: Diaspore: seed, dormancy mechanism and soil-stored seedbank (plants appeared in January after rain, two years after death of adult plants, D.H.B.).

Fire response: Killed after high intensity fire (1/94) at Narrabeen and Lane Cove, seedlings in less than 4 months, some plants flowering and fruiting within 1 year (P. Kubiak pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT NWS CWS; Qld, Vic., East Malesia, Polynesia.

Distribution Sydney area: Widespread.

Select locations: CC: Mooney Mooney Creek, Hornsby, Sans Souci, Campbelltown, Royal NP, Bulli Pass, Kiama, Springwood. CT: Culoul Range, Mt Hay, Kowmung River, Wolgan Valley.

Habitat

Habitat: Rocky areas, creeks, foreshores.

Altitude: 0–800 m **Annual rainfall:** 700–1400 mm

Typical local abundance: Occasional.

Vegetation: Moist open-forest e.g. with *Eucalyptus saligna*, *Angophora floribunda*, *E. blaxlandii*, *E. tereticornis*, *E. pilularis*, *Syncarpia glomulifera*; drier open-forest and woodland e.g. with *Corymbia eximia*, *E. crebra*, *E. tereticornis*. Also seacliff scrub e.g. with *Banksia integrifolia*, *Westringia fruticosa*, *Glochidion ferdinandii*. Swamp forest e.g. with *Casuarina glauca*; dry rainforest and gaps in subtropical rainforest (A. Bofeldt & M. Robinson pers. comm.).

Substrate: Clay soil on basalt, shale, sandstone, limestone, diatremes; high to low nutrient soils. Coal Measures, Budgong Sandstone, Bumbo Latite Member, Quaternary alluvium in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Full sun–light shade.

Conservation

Conservation: In Illawarra reported from Budderoo NP, Macquarie Pass NP, Illawarra SRA (A. Bofeldt & M. Robinson pers. comm.). Probably adequately conserved.

***Plectranthus verticillatus* ***

LAMIACEAE

Life history

Growth form: Pleasantly aromatic, soft, semi-succulent perennial herb to 25 cm high; prostrate branches root at nodes.

Vegetative spread: Prostrate stems root at nodes.

Longevity:

Primary juvenile period:

Flowers: White to pale mauve, April.

Fruit/seed: Dry fruit enclosed in calyx, 7 mm long at maturity.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to SE Africa.

Botanical subregions: CC.

Distribution Sydney area: Kariong.

Select locations: CC: Kariong (1928).

Habitat

Habitat:

Altitude: 0–300 m

Annual rainfall: 1200–1400 mm

Typical local abundance:

Vegetation:

Substrate:

Exposure:

Conservation

Conservation: Naturalised in Kariong district (Harden 1992), potential for spread unknown.

Prostanthera askania

LAMIACEAE

Tranquillity Mint-bush

Life history

Growth form: Erect openly-branched hairy shrub to 1–2.5 m high, rarely to 3 m, with toothed hairy leaves strongly aromatic.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Pale mauve to blue-mauve, September–December.

Fruit/seed: Enclosed by calyx, more than 5–6 mm long, mature July–December.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC

Distribution Sydney area: Gosford–Ourimbah area.

Select locations: CC: Askania Park, Kendall's Glen, Holgate, Narara, Niagara Park, Strickland SF, Ourimbah.

Habitat

Habitat: Sheltered gullies.

Altitude: 0–200 m

Annual rainfall: 1200–1400 mm

Typical local abundance: Rare.

Vegetation: Warm temperate rainforest; moist eucalypt open-forest e.g. with *Duboisia myoporoides*, *Trochocarpa laurina*.

Substrate: Sandy loams on Narrabeen shale and sandstones.

Exposure:

Conservation

Conservation: Local endemic species. Listed as a Vulnerable species under *Prostanthera* sp.

Strickland State Forest (J. Maiden s.n. 07/1915) on schedule II, NSW Threatened Species Conservation Act 1995. Not conserved in any conservation area. Endangered by urban development in the Niagara Park area of Gosford (Conn 1997).

Prostanthera caerulea

LAMIACEAE

Life history

Growth form: Erect, slightly aromatic shrub 0.5–3 m high.
Vegetative spread:
Longevity:
Primary juvenile period:
Flowers: White to bluish mauve, September–November, peak October.
Fruit/seed: Dry fruit enclosed in calyx 4–6 mm long, October–December.
Dispersal, establishment & growth:
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: NC CC SC NT CT; Qld.
Distribution Sydney area: Mainly Upper Blue Mountains.
Select locations: CC: Bilpin. CT: Mt Tomah, Lawson, Blackheath, Mt Banks, Bowens Creek, Mt Wilson.

Habitat

Habitat: Rocky areas and gullies.
Altitude: 500–1000 m **Annual rainfall:** 1000–1400 mm
Typical local abundance: Frequent–occasional.
Vegetation: Exposed montane heath and moist eucalypt open-forest e.g. with tree ferns.
Substrate: Skeletal sandy soil on sandstone, low nutrients, well-drained.
Exposure: Exposed to sheltered sites.

Conservation

Conservation: Not known.

Prostanthera cryptandroides

LAMIACEAE

Life history

Growth form: Low divaricate, strongly aromatic, sticky shrub 0.5–2 m high.
Vegetative spread:
Longevity:
Primary juvenile period:
Flowers: Lilac to mauve, September–April.
Fruit/seed: Dry fruit enclosed in calyx 6–7 mm long.
Dispersal, establishment & growth:
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: CT CWS.
Distribution Sydney area: Glen Davis district.
Select locations: CT: near Glen Davis, Mt Gundangaroo.

Habitat

Habitat: Dry rocky hillsides, below cliffs.
Altitude: 600–800 m **Annual rainfall:** 600–700 mm
Typical local abundance: Rare–occasional.
Vegetation: Eucalypt woodland to open-woodland e.g. with *Eucalytus sideroxylon*, *E. crebra*, *Acacia uncinata*, *Callitris endlicheri*.
Substrate: Sandy loam on sandstone, shale, often rocky, low nutrients.
Exposure:

Conservation

Conservation: Listed as vulnerable under schedule II, NSW Threatened Species Conservation Act 1995. Coded 2RC- t on national rare species list (Briggs & Leigh 1996).

Prostanthera densa

LAMIACEAE

Life history

Growth form: Erect, often compact aromatic, hairy shrub 0.5–2 m high. Probably includes *P. marifolia* in a broad sense; currently the latter species is regarded as presumed extinct (B. Conn pers. comm.).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Pale mauve to mauve, flowers sparingly throughout the year.

Fruit/seed: Dry fruit enclosed in calyx 6–8 mm long.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC.

Distribution Sydney area: Royal NP.

Select locations: CC: Cronulla, Audley, Marley.

Habitat

Habitat: Coastal headlands and near coastal ranges.

Altitude: 0–100 m

Annual rainfall: 1200–1400 mm

Typical local abundance: Rare.

Vegetation: Eucalypt forest e.g. with *Corymbia gumuifera*, *Angophora costata*, *Acacia terminalis*, *Banksia spinulosa* (Audley); tall shrubland e.g. with *Banksia integrifolia*, *Epacris longiflora*, *Pittosporum undulatum* (Cronulla).

Substrate: Sandstone outcrops, shallow soil, low nutrients.

Exposure:

Conservation

Conservation: Listed as vulnerable species under schedule II, NSW Threatened Species Conservation Act 1995. Coded 3VC- on national rare species list (Briggs & Leigh 1996). Endangered by urban development (Harden 1992). Royal NP populations last reported in 1972, status at Bass and Flinders Point, Cronulla not known.

Prostanthera denticulata

LAMIACEAE

Rough Mint Bush

Life history

Growth form: Straggling to subprostrate, aromatic shrub to 1 m high. Delimitation of species, *P. howelliae*, *P. marifolia* is unclear; the Victorian specimens referred to as *P. denticulata* appear to belong to a different taxon.

Vegetative spread: No.

Longevity:

Primary juvenile period: 3 years.

Flowers: Purple-mauve, September–December.

Fruit/seed: Dry fruit enclosed in calyx, September–November.

Dispersal, establishment & growth:

Fire response: Killed by high intensity fire (1/94) at Narrabeen (P. Kubiak pers. comm.), flowering prolifically after high intensity fire (1/94) at Katandra in less than 3 years (L.McD.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC.

Distribution Sydney area: Cowan to Manly.

Select locations: CC: Galston Gorge, Cowan, Towlers Bay, Church Point, Katandra, Bayview, Narrabeen Lakes, Manly.

Habitat: Hillsides, near creeks. Altitude: 0–50 m Annual rainfall: 1200 mm Typical local abundance: Frequent. Vegetation: Open-forest e.g. with <i>Eucalyptus botryoides</i> , <i>E. scias</i> , <i>E. paniculata</i> , <i>Corymbia maculata</i> , <i>Syncarpia glomulifera</i> , <i>Allocasuarina torulosa</i> ; woodland e.g. with <i>Eucalyptus sieberi</i> , <i>E. capitellata</i> with shrubby understorey e.g. with <i>Astrotricha floccosa</i> , <i>Acacia ulicifolia</i> , <i>Dodonaea triquetra</i> . Substrate: Sandy loam soils overlying Hawkesbury Sandstone and Narrabeen Group, medium nutrients, well-drained. Exposure:	Habitat
Conservation: Appears to be local endemic confined to Ku-Ring-Gai-Warringah area (Harden 1992). Conservation status unknown.	Conservation

Prostanthera granitica

LAMIACEAE

Growth form: Spreading shrub to 1 m high Vegetative spread: Longevity: Primary juvenile period: Flowers: Purple to mid-violet or occasionally white, September–October, peak October. Fruit/seed: Dry fruit enclosed in calyx 5 mm long. Dispersal, establishment & growth: Fire response: Interaction with other organisms:	Life history
Status/origin: Native. Botanical subregions: NT CT NWS CWS. Distribution Sydney area: Bathurst–Lithgow area. Select locations: CT: Newnes Plateau, Capertee Valley, Evans Crown.	Distribution

Habitat: Rocky crevices and ledges. Altitude: 600–1000 m Annual rainfall: 600–1100 mm Typical local abundance: Occasional–frequent. Vegetation: Pagoda Rock Complex (Benson & Keith 1990) heath e.g. with <i>Calytrix tetragona</i> , <i>Banksia spinulosa</i> , <i>B. ericifolia</i> , <i>Leptospermum arachnoides</i> , <i>Callitris endlicheri</i> ; eucalypt forest e.g. with <i>Eucalyptus sieberi</i> . Substrate: Shallow soils on sandstone terraces and pagodas, also in granite crevices. Low nutrient soils, sometimes in soaks and rocky gutters. Exposure:	Habitat
Conservation: Conservation status unknown.	Conservation

<i>Prostanthera hindii</i> (<i>Prostanthera</i> species D)	LAMIACEAE
Growth form: Erect subshrub to 1 m high. Vegetative spread: Longevity: Primary juvenile period: Flowers: Mauve, sometimes with a pinkish tinge, June–October. Fruit/seed: Dry fruit enclosed in calyx 5–8 mm long, seed 1.3–1.8 mm long, mature June–October. Dispersal, establishment & growth: Fire response: Interaction with other organisms:	Life history
Status/origin: Native. Botanical subregions: CT. Distribution Sydney area: Western Wollemi NP. Select locations: CT: Kandos Weir, Currant Mountain Gap, Glen Davis, Newnes Plateau.	Distribution
Habitat: Crevices and slopes of rocky sandstone pagoda outcrops. Altitude: 600–1000 m Annual rainfall: 700–1100 mm Typical local abundance: Frequent–occasional. Vegetation: Eucalypt woodland with shrubby understorey e.g. with <i>Calytrix tetragona</i> , <i>Platysace lanceolata</i> , <i>Lepidosperma</i> sp.; Pagoda Rock Complex (Benson & Keith 1990). Substrate: Restricted to shallow, quartz-rich, sandy soils in crevices and gutters of sandstone and conglomerate, low nutrient soils. Exposure: Shady sites.	Habitat
Conservation: Rare, local endemic species, not well known, conservation status unknown but has some protection in Wollemi NP (Conn 1997).	Conservation

<i>Prostanthera hirtula</i>	LAMIACEAE
Growth form: Spreading, strongly aromatic, hairy shrub 0.4–2 m high. Vegetative spread: Longevity: Primary juvenile period: Flowers: Dark mauve, October. Fruit/seed: Dry fruit enclosed in calyx 5–7 mm long, October–December. Dispersal, establishment & growth: Fire response: Interaction with other organisms:	Life history
Status/origin: Native. Botanical subregions: CC ST . Distribution Sydney area: Loftus–Otford, Southern Highlands. Select locations: CC: Mt Irvine (1924), Loftus, Otford, Jamberoo Mountain, Burrawang, Midway Rivulet.	Distribution
Habitat: Exposed rocky cliffs. Altitude: 0–700 m Annual rainfall: 900–1600 mm Typical local abundance: Frequent–occasional. Vegetation: Woodland, eucalypt forest; shrubland with <i>Leptospermum arachnoides</i> , <i>Hakea dactyloides</i> , <i>Grevillea ramosissima</i> . Substrate: Shallow sandy on sandstone, low nutrients, skeletal soil, low nutrients. Exposure:	Habitat
Conservation: Collection for Loftus–Otford area all made pre-1900 and Mt Irvine (1924). Conservation status unknown.	Conservation

Prostanthera howelliae

LAMIACEAE

Life history

Growth form: Erect or low spreading shrub 0.3–1 m high.
Vegetative spread:
Longevity:
Primary juvenile period:
Flowers: Pink–purple-mauve, with dark red dots, mainly September–October.
Fruit/seed: Dry capsule surrounded by calyx, September–November.
Dispersal, establishment & growth:
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: NC CC CT ?ST NWS CWS SWS NWP; Qld, Vic.
Distribution Sydney area: Sporadic.
Select locations: CC: Sackville, Maroota, Hillside, Lane Cove (1927), Hunters Hill (1898).
CT: Mt Norris (Bungleboori), Four Mile Creek (S of Orange), Bundanoon.

Habitat

Habitat: Ridges, hillsides.
Altitude: 0–1000 m **Annual rainfall:** 800–1200 mm
Typical local abundance: Occasional.
Vegetation: Woodland e.g. with *Corymbia eximia*, *C. gummifera*, *Eucalyptus punctata*, *E. squamosa*, *Leptospermum trinervium*, *Hakea dactyloides*, *Grevillea speciosa*, *Boronia ledifolia*, *Calytrix tetragona*, *Pimelea linifolia*.
Substrate: Sandy loamy soils, often with ironstone gravel, overlying sandstone.
Exposure: Full sun to light shade.

Conservation

Conservation: Rare in Sydney region and probably not adequately conserved.

Prostanthera incana

LAMIACEAE

Velvet Mint-bush

Life history

Growth form: Erect, slightly aromatic, hairy shrub 1–2.5 m high.
Vegetative spread:
Longevity:
Primary juvenile period:
Flowers: Lilac, September–December.
Fruit/seed: Dry fruit enclosed in calyx 4–6 mm long, September–December.
Dispersal, establishment & growth:
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: NC CC SC; Vic.
Distribution Sydney area: Blue Mountains, Southern Highlands.
Select locations: CC: Springwood, Erskine Creek, Nortons Basin, Kangaroo Valley, Belmore Falls, Kiama, Blackheath, Penrose, Wingello.

Habitat

Habitat: Hillslopes near creeks.
Altitude: 0–1000 m **Annual rainfall:** 800–1400 mm
Typical local abundance: Occasional.
Vegetation: Gully rainforest (at Blackheath), moist tall eucalypt open-forest e.g. with *Goodenia ovata*; woodland e.g. with *Corymbia eximia*, *Eucalyptus beyeriana*, *Acacia binervia*, *Lasiopetalum ferrugineum*.
Substrate: Skeletal sandy loamy soils on sandstone, medium nutrients.
Exposure:

Conservation

Conservation: Conservation status unknown.

Prostanthera incisa

LAMIACEAE

Cut-leaved Mint-bush

Life history

Growth form: Erect, strongly and unpleasantly aromatic, hairy shrub. Further study required to distinguish various forms included in this complex.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Pale mauve to mauve, September–November.

Fruit/seed:

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CT.

Distribution Sydney area: Widespread.

Select locations: CC: Ourimbah, Wheeny Creek, Mountain Lagoon, Otford, Lilyvale, Bulli Pass. CT: Mt Coricudgy, Narrowneck.

Habitat

Habitat: Sheltered gorges.

Altitude: 0–800 m

Annual rainfall: 1000–1600 mm

Typical local abundance: Frequent–occasional.

Vegetation: Margins of rainforest; open-forest e.g. with *Eucalyptus saligna*, *E. amplifolia*, *E. piperita*, *Corymbia gummifera*, *Syncarpia glomulifera*; riparian scrub with *Casuarina cunningghamiana*.

Substrate: Sandy soils on sandstone, alluvium, medium nutrients.

Exposure:

Conservation

Conservation: Conservation status unknown.

***Prostanthera junonis* (*Prostanthera* species Somersby)**

LAMIACEAE

Somersby Mintbush

Life history

Growth form: Low spreading, decumbent, weak subshrub 0.1–0.3 m high, with non-aromatic leaves.

Vegetative spread: Stoloniferous, clonal (Conn 1997).

Longevity: Indefinite.

Primary juvenile period:

Flowers: Small, very pale mauve to almost white, with dull yellow-orange to pale brown dots, October–February, peak October.

Fruit/seed: Dry fruit enclosed by calyx, seed 1.5–2 mm long, mature October–February.

Dispersal, establishment & growth: Diaspore: seed, difficult to germinate, seed viability 30% with 30% of viable seeds germinating in response to smoke; coloniser (Conn 1997).

Fire response: Probably resprouts from underground stems, 9% seeds germinate in response to smoke (B. Conn pers. comm.).

Interaction with other organisms: Reshoots in response to disturbance e.g. opening of canopy, mechanical scraping during land clearing (B. Conn. pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: CC.

Distribution Sydney area: Somersby Plateau (Gosford area).

Select locations: CC: Kulnura, Mangrove Mountain, Somersby, Mooney Mooney.

Habitat

Habitat: Drainage lines, seepage areas.
Altitude: 0–100 m **Annual rainfall:** 1400 mm
Typical local abundance: Clonal, difficult to assess number of individuals on any one site (Conn 1997).
Vegetation: Eucalypt open woodland e.g. with *Corymbia gummiifera*, *Angophora costata*, *A. hispida*, *Eucalyptus haemastoma*, *E. piperita*, *E. punctata*, *E. sieberi* with shrubby understorey including *Acacia oxycedrus*, *A. suaveolens*, *Banksia cricifolia*, *B. serrata*, *Dillwynia floribunda*, *Epacris obtusifolia*, *Grevillea buxifolia*, *Kunzea capitata*, *Petrophile pulchella*.
Substrate: Coarse gravelly white-grey sandy soils (Conn 1997) and yellow loam overlaying Hawkesbury Sandstone.
Exposure:

Conservation

Conservation: Local endemic, listed as endangered species under schedule 1, NSW Threatened Species Conservation Act 1995 as *Prostanthera* sp. Somersby (B.J. Conn 4024). This species is regarded as extremely rare, highly endangered and not conserved, coded 2E on national rare species list (Briggs & Leigh 1996). The habitat of all known populations has been severely disturbed. Sites have been extensively cleared for urban development with extensive removal and/or partial relocation of soil; activities such as horse-riding and trail-bike riding present serious threats to survival of populations (Conn 1997).

Prostanthera lasianthos

LAMIACEAE

Victorian Christmas Bush

Life history

Growth form: Shrub to small tree, usually 1–6 m high, aromatic. This species is variable and a number of different forms are recognised in Harden (1992), of which the ‘typical variant’ and rheophytic variant occur in the Sydney area.
Vegetative spread:
Longevity:
Primary juvenile period:
Flowers: White to pale mauve with purple spots in throat, November–March.
Fruit/seed: Dry fruit enclosed by calyx.
Dispersal, establishment & growth: Diaspore: fruit. Seed loses viability after 3 months storage at room temperature (Floyd 1989).
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: SC CC NT CT ST NWS; Qld, Vic., Tas.
Distribution Sydney area: Widespread.
Select locations: CC: Bulli Pass, Macquarie Falls, Carrington Falls, Fitzroy Falls, Hilltop, Kurrajong. CT: Mt Wilson, Hartley, Bindook Falls, Winburndale NR, Mt Werong, Wingello.

Habitat

Habitat: Moist gullies, watercourses, rocky cliffs.
Altitude: 0–1000 m **Annual rainfall:** 700–1400 mm
Typical local abundance: Frequent-occasional.
Vegetation: Rainforest e.g. with *Doryphora sassafras*, *Ceratopetalum apetalum*; moist forest e.g. with *Acacia elata*, *Eucalyptus fastigata*; drier forest e.g. with *Eucalyptus tereticornis*, *Casuarina cunninghamiana*.
Substrate: Sandy soil on sandstone, quartzite, granite, alluvium, also basalt. Low to high nutrient soils.
Exposure:

Conservation

Conservation:

Prostanthera linearis

LAMIACEAE

Narrow-leaved Mint-bush

Life history**Growth form:** Erect, slightly aromatic shrub 1–3 m high.**Vegetative spread:****Longevity:** 25–60 years (D. Keith pers. comm.).**Primary juvenile period:****Flowers:** White, often with pinkish to mauve tinge, September–March, peak November. Flowers visited by native bees (?*Exoneura* sp., ?Anthophoridae), honey bees probably for nectar, and hoverfly (Syrphidae), grey weevil (Curculionidae) probably feeding on pollen (P. Kubiak pers. comm.).**Fruit/seed:** Dry fruit enclosed in calyx to 5 mm long.**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.), or mechanical disturbance (A. Bofeldt & M. Robinson pers. comm.).**Fire response:** Killed by fire (D. Keith pers. comm.), killed by high intensity fire (1/94) at Lane Cove and Narrabeen, but a couple resprouted from base; seedlings flowered within 3 years (P. Kubiak pers. comm.). Seed possibly stimulated by fire or smoke (A. Bofeldt & M. Robinson pers. comm.).**Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** CC SC CT ST.**Distribution Sydney area:** Mainly coast and Wollemi.**Select locations:** CC: Wondabyne, Cowan Creek, Frenchs Forest (L.McD.), Lane Cove, Georges River, Port Hacking River, Woronora River, Appin, Dapto, Springwood.

CT: Bungleboori Creek, Angorawa Creek, Glen Davis, Wingello.

Habitat**Habitat:** Riverbanks, hillsides, ridgetops.**Altitude:** 0–800 m**Annual rainfall:** 1000–1200 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Eucalypt open-forest e.g. with *Angophora costata*, *Syncarpia glomulifera*, *Eucalyptus piperita*, *Corymbia gumuifera*, *Eucalyptus punctata* or *Eucalyptus tereticornis*, *E. eugenioides* (A. Bofeldt & M. Robinson pers. comm.); riparian scrub e.g. with *Tristaniopsis laurina*, *Lomatia myricoides*, *Callicoma serratifolia*; scrub to open scrub e.g. with *Melaleuca armillaris* (A. Bofeldt & M. Robinson pers. comm.).**Substrate:** Shallow sandy soils on sandstone, gravelly clays, alluvium, low nutrients. Shallow soils, Bumbo Latite Member in Illawarra (A. Bofeldt & M. Robinson pers. comm.).**Exposure:****Conservation****Conservation:** Conservation status unknown, not conserved in Illawarra (A. Bofeldt & M. Robinson pers. comm.).***Prostanthera ovalifolia* s. lat.**

LAMIACEAE

Life history**Growth form:** Spreading to dense shrub 1–4 m high. Includes *P. lanceolata* and *P. cineolifera*. Many forms of this species are commonly cultivated.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Mauve or deep blue-purple, rarely white, September–November.**Fruit/seed:** Dry fruit enclosed in calyx 6 mm at maturity, September–November.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native.
Botanical subregions: NC CC SC CWS SWP; Qld, Vic.

Distribution Sydney area:

Select locations: CC: Wollombi, Glen Davis, Wisemans Ferry, Wattagan SF, Cowan, Hornsby, Beecroft, Springwood, Campbelltown.

Habitat

Habitat:

Altitude: 0–500 m

Annual rainfall:

Typical local abundance: Occasional–frequent.

Vegetation: Moist eucalypt forest; eucalypt open-forest e.g. with *Eucalyptus piperita*, *Astrotrichia floccosa*, *Platysace lanceolata*, *Callicoma serratifolia*; open-woodland e.g. with *Corymbia eximia*, *Angophora*, *Acacia*, *Pimelea*, *Grevillea buxifolia*, *Leptospermum*, *Hakea dactyloides*.

Substrate: Sandy soil on Hawkesbury Sandstone, yellow clay, low nutrients.

Exposure: Sheltered, light shade.

Conservation

Conservation: Not known.

Prostanthera phyllicifolia

LAMIACEAE

Life history

Growth form: Slightly aromatic shrub 0.5–2 m high.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: White to pale lilac with purple and yellow spots, October–January.

Fruit/seed: Dry fruit enclosed in calyx 4–5 mm long at maturity.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NT CT ST SC; Qld, Vic.

Distribution Sydney area:

Select locations: CT: Wentworth Falls (1898).

Habitat

Habitat: Granite outcrops and hillsides.

Altitude:

Annual rainfall:

Typical local abundance:

Vegetation: Eucalypt forest and heath.

Substrate: Shallow sandy soils.

Exposure:

Conservation

Conservation:

Prostanthera prunelloides

LAMIACEAE

Life history

Growth form: Erect to spreading, slightly aromatic shrub 1.5–2 m high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** White with faint mauve tinge, or pale mauve or rarely with pink tinge, spring.**Fruit/seed:** Dry fruit enclosed in calyx 5–6.5 mm long, slightly enlarged at maturity.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** NC CC SC CWS CT ST.**Distribution Sydney area:** Putty, Lower Blue Mountains.**Select locations:** CC: Putty, Grose Vale. CT: Grose River, Glenbrook Creek, Springwood.

Habitat

Habitat: Creeks, gullies, hillsides.**Altitude:** 0–500 m**Annual rainfall:** 900–1200 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Eucalypt forest and woodland e.g. with *Angophora bakeri*, *Corymbia eximia*, and shrubby understorey e.g. with *Lambertia formosa*, *Leptospermum trinervium*, *Pultenaea flexilis*, *Podocarpus spinulosus*.**Substrate:** Sandy soils over sandstone, and sandy alluvium, low nutrients.**Exposure:**

Conservation

Conservation: Not known.*Prostanthera rhombea*

LAMIACEAE

Life history

Growth form: Spreading, strongly aromatic, hairy shrub 0.5–2 m high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Mauve or bluish, often white at ends of branches, September–December, peak October.**Fruit/seed:** Dry fruit enclosed in calyx 4–5 mm long, slightly enlarged at maturity, September–December.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** NC CC CT NWS CWS; Qld, Vic.**Distribution Sydney area:** Mainly Blue Mountains.**Select locations:** CC: Wondabyne, Erskine Creek, Douglas Park, Picton, Bargo, Angorawa Creek, Colo River. CT: Mt Irvine, Bowens Creek, Wolgan Gap, Katoomba, Mt Cookem.

Habitat

Habitat: Sheltered hillsides, gullies, riverbanks.**Altitude:** 0–1000 m**Annual rainfall:** 900–1400 mm**Typical local abundance:** Occasional.**Vegetation:** Open-forest e.g. with *Eucalyptus globoidea*, *E. sieberi*, *E. piperita*, *Angophora costata*, *E. oreades*, *Syncarpia glomulifera*; occasionally in rainforest.**Substrate:** Sandy loam on sandstone, conglomerate, occasionally basalt, low to high nutrients.**Exposure:**

Conservation

Conservation: Not known.

Prostanthera rotundifolia

LAMIACEAE

Round-leaved Mint Bush

Life history

Growth form: Erect, aromatic, hairy shrub. Leaves are extremely variable (Harden 1992).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Purple-mauve to purple, September–October.

Fruit/seed: Dry fruit enclosed in calyx 4–5 mm long, September–October.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC NT CT ST NWS CWS SWS NWP; Qld, Vic., Tas.

Distribution Sydney area: Blue Mountains, Southern Highlands.

Select locations: CC: Colo Heights. CT: Tunnel Creek, Newnes Plateau, Glen Davis, Tallong, Wingello.

Habitat

Habitat: Rocky hillsides, below cliffs, along creeks.

Altitude: 0–1100 m **Annual rainfall:** 900–1200 mm

Typical local abundance: Occasional–frequent.

Vegetation: Eucalypt open-woodland e.g. with *Eucalytus sieberi*, *E. punctata*, *Leptospermum polygalifolium*; riparian scrub with *Casuarina cunninghamiana*.

Substrate: Sandy to sandy-loam soils on sandstone, sandy alluvium, low nutrients.

Exposure:

Conservation

Conservation: Conservation status unknown.

Prostanthera rugosa

LAMIACEAE

Life history

Growth form: Open, aromatic hairy shrub.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Mauve with a white tinge, September–October.

Fruit/seed: Dry fruit enclosed in calyx 4–5 mm long, enlarged at maturity.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CT.

Distribution Sydney area: Mainly Southern Highlands.

Select locations: CT: Howes Mountain, Tonalli River, Yerranderie, Mittagong, Joadja, Belanglo SF.

Habitat

Habitat: Creek banks, rocky hillsides, ridge.

Altitude: 500–700 m **Annual rainfall:** 800–900 mm

Typical local abundance: Rare–occasional.

Vegetation: Moist eucalypt forest; dry eucalypt forest e.g. with *Eucalyptus sieberi*, *E. punctata*; mallee e.g. with *Eucalyptus apiculata*, *Hakea dactyloides*.

Substrate: Shallow to deep soils on sandstone, quartzite.

Exposure:

Conservation

Conservation: Conservation status unknown.

Prostanthera saxicola

LAMIACEAE

Life history**Growth form:** Spreading or mat-forming shrub to 1 m across.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** White to mauve or bluish, September–December.**Fruit/seed:** Dry fruit enclosed in calyx 4–5 mm long, slightly enlarged at maturity.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** SC CT NWS CWS.**Distribution Sydney area:****Select locations:** CC: Arncliffe (1893), Penshurst (1897), Menai, Woronora.

CT: Kandos Weir, Newnes Plateau, Narrowneck, Katoomba, Kanangra.

Habitat**Habitat:** Rocky ridges, creek bed.**Altitude:** 0–1200 m**Annual rainfall:** 1000–1200 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Eucalypt forest and heath e.g. with *Hakea dactyloides*, *Brachyloma daphnoides*, *Banksia spinulosa*, *Baeckea brevifolia*, *Epacris pulchella*, *Acacia myrtifolia*, *A. ulicifolia*; closed heath e.g. with *Allocasuarina nana*, *Lepidosperma viscidum*.**Substrate:** Skeletal sandy soil to sandy loam over sandstone, low nutrients.**Exposure:** Full sun to light shade.**Conservation****Conservation:** Conservation status unknown.***Prostanthera scutellarioides***

LAMIACEAE

Life history**Growth form:** Erect or decumbent shrub 0.3–2.5 m high, faintly aromatic; branches ridged and hairy.**Vegetative spread:** No.**Longevity:** 25 years?**Primary juvenile period:** 3 years.**Flowers:** Pale to deep mauve, often with purple or bluish tinge, June–October, peak October.**Fruit/seed:** Dry fruit enclosed in calyx 3–4.5 mm long, sometimes slightly enlarged at maturity, July–November, peak October.**Dispersal, establishment & growth:** Diaspore: seed, probably some dormancy. Recruitment episodic, particularly after fire.**Fire response:** Killed by fire, recruits from soil-stored seed.**Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC NT ST; Qld.**Distribution Sydney area:** Castlereagh area.**Select locations:** CC: Berkshire Park, Llandillo, Castlereagh NR, St Marys, Helensburgh (1889).

		Habitat
Habitat: Dry forest.		
Altitude: 0–200 m	Annual rainfall: 800–900 mm	
Typical local abundance: Frequent–occasional.		
Vegetation: Eucalypt open-forest and woodland e.g. with <i>Angophora bakeri</i> , <i>Eucalyptus sclerophylla</i> , <i>E. fibrosa</i> , <i>E. beyeriana</i> , <i>Melaleuca decora</i> , with shrubby understorey including <i>Dillwynia tenuifolia</i> , <i>Acacia elongata</i> , <i>Hakea sericea</i> , <i>Pultenaea villosa</i> , <i>Micromyrtus minutiflora</i> .		
Substrate: Sandy loams to sandy clays on Tertiary alluvial deposits, often with ironstone gravels. Low nutrient soils.		
Exposure: Light shade.		
		Conservation
Conservation: Locally confined to Castlereagh area. Vulnerable in Western Sydney (Benson & McDougall 1991).		

Prostanthera species A

LAMIACEAE

		Life history
Growth form: Erect, aromatic slender, hairy shrub 1.5–2.5 m high.		
Vegetative spread:		
Longevity:		
Primary juvenile period:		
Flowers: Violet to mauve, spring.		
Fruit/seed: Dry fruit enclosed in calyx 4–5 mm long.		
Dispersal, establishment & growth:		
Fire response:		
Interaction with other organisms:		
		Distribution
Status/origin: Native.		
Botanical subregions: CT CWS.		
Distribution Sydney area: Rylstone district.		
Select locations: CT: Rylstone district.		
		Habitat
Habitat: Sandstone outcrops.		
Altitude:	Annual rainfall:	
Typical local abundance:		
Vegetation: <i>Callitris endlicheri</i> – <i>Eucalyptus rossii</i> forest (Harden 1992).		
Substrate: Sandy loamy soils.		
Exposure:		
		Conservation
Conservation: Confined to Rylstone district (Harden 1992).		

Prostanthera species C

LAMIACEAE

Life history

Growth form: Erect or sprawling shrub 0.7–2 m high.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Purple-violet to pinkish, spring.

Fruit/seed: Dry fruit enclosed in calyx 6–8 mm long.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CT CWS.

Distribution Sydney area: Ben Bullen SF, Orange district.

Select locations: CT:

Habitat

Habitat:

Altitude:

Annual rainfall:

Typical local abundance:

Vegetation:

Substrate: Quartz-rich, sandstone-derived soils (Harden 1992).

Exposure:

Conservation

Conservation:

Prostanthera stricta

LAMIACEAE

Life history

Growth form: Erect, aromatic, hairy shrub to 2 m high.

Vegetative spread: Often clonal (Harden 1992), presumably spread by root suckers.

Longevity:

Primary juvenile period:

Flowers: Pale mauve to deep purple, winter–spring.

Fruit/seed: Dry fruit enclosed in calyx 4–5 mm long, sometimes slightly enlarged at maturity.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin:

Botanical subregions: CT CWS.

Distribution Sydney area: Capertee.

Select locations: CT: Capertee, Running Stream.

Habitat

Habitat: Rocky slopes, cliff edges.

Altitude: 800–1000 m

Annual rainfall: 600–700 mm

Typical local abundance: Occasional–frequent.

Vegetation: Eucalypt open-forest e.g. with *Eucalyptus blaxlandii*, *E. caunouii*, *E. viminalis*, *Acacia inplexa*, *Goodenia ovata*.

Substrate: Sandy loam over sandstone below edge of basalt cap, low–medium nutrient soils.

Exposure:

Conservation

Conservation: Listed as vulnerable under schedule II, NSW Threatened Species Conservation Act 1995. Coded 2V on national rare species list (Briggs & Leigh 1996).

Prostanthera violacea

LAMIACEAE

Life history

Growth form: Slender, strongly aromatic, hairy shrub 0.5–2 m high.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Mauve or bluish, or white at ends of branches, August–December, peak September.

Fruit/seed: Dry fruit enclosed in calyx 4–5 mm long, sometimes slightly enlarged at maturity, September–December.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC CT NWS CWS; Qld, Vic.

Distribution Sydney area: Mainly lower Blue Mountains.

Select locations: CC: Cowan, Royal NP, Kurrajong Heights, Grose Vale, Valley Heights, Erskine Creek, Picton. CT: Blackheath.

Habitat

Habitat: Gullies or riverbanks, below falls.

Altitude: 0–1000 m **Annual rainfall:** 900–1200 mm

Typical local abundance: Frequent–occasional.

Vegetation: Moist eucalypt open-forest e.g. with *Angophora costata*, *Eucalyptus piperita*, *Syncarpia glomulifera*, *Acmena smithii*, and shrubby understorey e.g. with *Pultenaea flexilis*, *Gompholobium latifolium*, *Ceratopetalum gummiferum*.

Substrate: Sandy to sandy-loam soils on sandstone, alluvium.

Exposure:

Conservation

Conservation: Not known.

***Prunella laciniata* ***

LAMIACEAE

Molucca Balm

Life history

Growth form: Perennial densely hairy herb with decumbent branches to 30 cm long.

Vegetative spread: Decumbent stems with adventitious roots.

Longevity:

Primary juvenile period:

Flowers: Yellowish white, or rarely rose-pink or purplish.

Fruit/seed: Dry with 4 segments.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to Europe.

Botanical subregions: CC CT.

Distribution Sydney area: Colo River to Bowral (Harden 1992).

Select locations: CT: Burradoo (1993) only record.

Habitat

Habitat: Lawns.

Altitude: 0–600 m **Annual rainfall:** 900–1200 mm

Typical local abundance:

Vegetation:

Substrate:

Exposure: Full sun.

Conservation

Conservation: Uncommon weed.

***Prunella vulgaris* ***

LAMIACEAE

Self-heal

Life history

Growth form: Erect perennial herb with decumbent branches to 50 cm long, often with adventitious roots.

Vegetative spread: Decumbent stems with adventitious roots.

Longevity:

Primary juvenile period: 1 year.

Flowers: Deep purple-blue, November–April.

Fruit/seed: Dry, 4 segments.

Dispersal, establishment & growth: Seeds dispersed by water, animals and man, germinates in spring (Ciba-Geigy 1968–).

Fire response: Probably killed by high intensity fire (1/94) at Lane Cove, seedlings flowering and fruiting within 1 year (P. Kubiak pers. comm.).

Interaction with other organisms: Flowers visited by native bee ?*Amegilla* sp. (Anthophoridae) Blue Banded Bee, probably for nectar; shoots apparently eaten by rabbits *Oryctolagus cuniculus* (P. Kubiak pers. comm.).

Distribution

Status/origin: Exotic, native to Europe.

Botanical subregions: CC SC NT CT ST CWS SWS; Qld, Vic., Tas., S.A.

Distribution Sydney area: Widespread.

Select locations: CC: Pennant Hills Park, North Rocks (L.McD.), Mt Keira. CT: Long Swamp, Wildes Meadow, Wingecarribee Swamp (Kodala et al. 1992).

Habitat

Habitat: Disturbed areas, roadsides, creekbanks; upland swamps, moist pasture (P. Kodala pers. comm.).

Altitude: 0–700 m

Annual rainfall: 1000–1800 mm

Typical local abundance: Frequent.

Vegetation: Open-forest e.g. with *Angophora costata*, *Callicoma serratifolia*; roadside weeds; sedgeland with *Carex* spp. etc.

Substrate: Sandy-loamy soils on sandstone, peat, medium nutrients.

Exposure: Full sun to light shade.

Conservation

Conservation: Invades disturbed edges and disturbed creekbanks, but probably not a major problem. Moderate competitor for space and nutrients (Ciba-Geigy 1968–).

***Salvia coccinea* ***

LAMIACEAE

Life history

Growth form: Slender perennial herb to 1 m high, with hairs on branches.

Vegetative spread: Probably has limited spread by rhizome (Anon 1991).

Longevity:

Primary juvenile period:

Flowers: Bright red, rarely pink, March–June.

Fruit/seed: Dry, segmented fruit.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to tropical America, probably introduced as a garden plant.

Botanical subregions: NC CC SC; LHI, Qld.

Distribution Sydney area: Sporadic.

Select locations: CC: Manly (1980), Razorback (1945), Albion Park (1942).

		Habitat
Habitat:	Creekbanks.	
Altitude:	0–300 m	Annual rainfall: 700–1200 mm
Typical local abundance:		
Vegetation:		
Substrate:		
Exposure:		
		Conservation
Conservation:	Sporadically naturalised.	

Salvia plebeia

LAMIACEAE

		Life history
Growth form:	Perennial herb 40–90 cm high, densely covered with hairs.	
Vegetative spread:		
Longevity:		
Primary juvenile period:		
Flowers:	Violet, purplish or blue, at any time of year, peak March–April.	
Fruit/seed:	Dry, segmented fruit, March–April.	
Dispersal, establishment & growth:		
Fire response:		
Interaction with other organisms:		
		Distribution

Status/origin: Native.
Botanical subregions: NC NT CT NWS CWS; Qld, Malesia.
Distribution Sydney area: Bathurst area.
Select locations: CT: Bathurst, Lewis Ponds, Forest Reefs, Kelso, Tuglow Caves (1966).

		Habitat
Habitat:	Open areas, creekbanks.	
Altitude:	600–1000 m	Annual rainfall: 600–900 mm
Typical local abundance:		
Vegetation:	Open areas in forest.	
Substrate:	Shallow soil on limestone.	
Exposure:		
		Conservation
Conservation:	Tuglow is southern geographical limit. Mostly old records, last collected 1966. Conservation status unknown.	

***Salvia reflexa* ***

LAMIACEAE

Mintweed

Life history

Growth form: Subshrub to 60 cm high, with hairy branches, opposite leaves, and strong scent of mint.

Vegetative spread: No.

Longevity: Less than 1 year.

Primary juvenile period: Less than 1 year.

Flowers: Pale blue, October–May.

Fruit/seed: Dry, segmented fruit, separating into 4 nutlets at maturity; seed 2 mm long, May.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms: Fatal poisoning of sheep and young cattle reported (Harden 1992) but generally unpalatable (Felfoldi 1993).

Distribution

Status/origin: Exotic, native to N America.

Botanical subregions: NC CC SC NT NWS CWS NWP SWP NFWP; *Qld, *Vic., *S.A.

Distribution Sydney area: Sporadic.

Select locations: CC: Dural (1988), Liverpool (1984).

Habitat

Habitat: Near animal enclosures.

Altitude: 0–300 m

Annual rainfall: 800–900 mm

Typical local abundance: Rare.

Vegetation:

Substrate:

Exposure:

Conservation

Conservation: More common in western NSW but rarely naturalised in Sydney area. Sydney occurrences possibly result of introduction of lucerne hay from western NSW or dumping of aviary droppings (Herbarium specimen).

***Salvia verbenaca* ***

LAMIACEAE

Wild Sage

Life history

Growth form: Perennial hairy herb to 70 cm high, a variable species.

Vegetative spread: No (McIntyre et al. 1995).

Longevity:

Primary juvenile period:

Flowers: Blue-purple to lilac, at any time of year.

Fruit/seed: Dry, segmented.

Dispersal, establishment & growth: No particular morphology for dispersal (McIntyre et al. 1995).

Fire response:

Interaction with other organisms: Seed eaten by Crimson Rosella *Platycercus elegans* (Lepschi 1993). Foodplant of Stubble Quail *Coturnix pectoralis* (Barker & Vestjens 1989, 1990). Foodplant of moth larvae *Anisacta eurymochla* (Common 1990).

Distribution

Status/origin: Exotic, native to S & W Europe and N Africa.

Botanical subregions: CC SC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., S.A.

Distribution Sydney area: Western Sydney, Bathurst–Orange.

Select locations: CC: Richmond (1910), Menangle. CT: Mt Cameron, Blayney, O'Connell (1902).

	Habitat
Habitat: Disturbed areas, railways, cultivated soil.	
Altitude: 0–1000 m	Annual rainfall: 700–800 mm
Typical local abundance:	
Vegetation: Moist eucalypt forest e.g. with <i>Eucalyptus viminalis</i> , <i>E. radiata</i> .	
Substrate: Clay soils on basalt, high nutrients.	
Exposure:	
	Conservation
Conservation: Commonly naturalised in disturbed areas.	

Scutellaria humilis LAMIACEAE

Dwarf Skullcap **Life history**

Growth form: Perennial herb, with hairs along ridges of branches.	
Vegetative spread:	
Longevity:	
Primary juvenile period:	
Flowers: Pale purplish red with white markings, mainly October–April.	
Fruit/seed: Dry paper capsule with 4 segments, September–April.	
Dispersal, establishment & growth:	
Fire response:	
Interaction with other organisms:	

Distribution

Status/origin: Native.	
Botanical subregions: NC CC SC NT CT ST NWS CWS SWS; Qld, Vic., Tas., S.A.	
Distribution Sydney area: Western Sydney, Tablelands.	
Select locations: CC: Penshurst (1898), Greystanes, East Hills, Cobbitty, Razorback. CT: Grose River, Rylstone, Mt Canobolas, Limekilns, Jenolan Caves, Bowral, Wombeyan Caves.	

Habitat

Habitat: Often moist sheltered areas.	
Altitude: 0–1000 m	Annual rainfall: 600–1000 mm
Typical local abundance: Frequent–occasional.	
Vegetation: Woodland e.g. with <i>Eucalyptus moluccana</i> , <i>E. tereticornis</i> , <i>E. bridgesiana</i> , <i>Brachychiton populneus</i> with grassy understorey e.g. with <i>Themeda australis</i> , <i>Aristida ramosa</i> .	
Substrate: Clay loam on sandstone, shale, basalt, limestone, medium–high nutrients.	
Exposure: Mid shade.	

Conservation

Conservation: Vulnerable in Western Sydney (Benson & McDougall 1991).	
Conservation status elsewhere unknown.	

Scutellaria mollis

LAMIACEAE

Soft Skullcap

Life history**Growth form:** Perennial herb.**Vegetative spread:** Suckering (M. Robinson pers. comm.).**Longevity:****Primary juvenile period:****Flowers:** White with pink markings, pink, mauve, mainly October–March.**Fruit/seed:** Dry fruit with 4 segments.**Dispersal, establishment & growth:** Colonised gap in warm temperate rainforest caused by landslip (M. Robinson pers. comm.).**Fire response:****Interaction with other organisms:**

Distribution**Status/origin:** Native.**Botanical subregions:** ?NC CC SC; Vic.**Distribution Sydney area:****Select locations:** CC: Culoul Range, Mooney Mooney, Bayview (1941), Mt Keira, Cordeaux, Burragorang.

Habitat**Habitat:** Rocky areas. Gaps in warm temperate rainforest e.g. after landslide (M. Robinson pers. comm.).**Altitude:** 0–600 m**Annual rainfall:** 900–1200 mm**Typical local abundance:** Frequent–rare.**Vegetation:** Moist tall open-forest e.g. with *Syncarpia glomulifera*, *Calochlaena dubia*, *Blechnum cartilagineum*; rainforest/moist forest ecotone; warm temperate rainforest e.g. with *Ceratopetalum apetalum*, *Cryptocarya glaucescens*, *Doryphora sassafras* (Thomas 1990).**Substrate:** Clay soils from shales, basalt, volcanic rocks, medium to high nutrients.**Exposure:** Shade-tolerant (M. Robinson pers. comm.).

Conservation**Conservation:** A relatively rarely collected species, conservation status unknown.

Colo area may be northern geographical limit. Rare in Illawarra (M. Robinson pers. comm.).

Scutellaria racemosa *

LAMIACEAE

Life history**Growth form:** Perennial herb.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** White or pink to mauve with dark purple markings, mainly October–February.**Fruit/seed:** Dry, segmented**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution**Status/origin:** Exotic, native America.**Botanical subregions:** CC.**Distribution Sydney area:** South western Sydney suburbs.**Select locations:** CC: Auburn, Bass Hill (1957), Casula, Liverpool, Macquarie Fields.

Habitat**Habitat:** Moist shaded sites, creek banks, watercourses.**Altitude:** 0–100 m**Annual rainfall:** 700–1000 mm**Typical local abundance:** Frequent.**Vegetation:** Open-forest e.g. with *Eucalyptus fibrosa*, *E. eugenoides*, *Melaleuca decora*, *M. nodosa*.**Substrate:** Clay soils on Wianamatta Shale and sandstone along creeks.**Exposure:** Mid shade.

Conservation**Conservation:** Recently naturalised in southwestern suburbs and in gardens.

Potential for invasive spread as other weed species tolerant of shady conditions and drainage lines have become major weeds.

***Stachys arvensis* ***

LAMIACEAE

Stagger Weed

Life history**Growth form:** Herb to 35 cm high, with opposite leaves; branches densely hairy.**Vegetative spread:****Longevity:** Less than 1 year.**Primary juvenile period:** Less than 1 year.**Flowers:** White or pale pink, February–October.**Fruit/seed:** Dry fruit, splitting into 4, 1-seeded units.**Dispersal, establishment & growth:****Fire response:** Probably killed by intensity fire (1/94) at Lane Cove, seedlings flowering and fruiting within 6 months (P. Kubiak pers. comm.).**Interaction with other organisms:** If eaten by livestock, causes 'staggers' and sometimes death (Harden 1992). Contaminant of lucerne (Bailey 1906).**Distribution****Status/origin:** Exotic, native to SW & C Europe, N Africa, ?N America.**Botanical subregions:** NC CC SC CT NWS CWS NWP; Qld, Vic., Tas., S.A., W.A.**Distribution Sydney area:** Widespread.**Select locations:** CC: Wollombi, Kenthurst, Cheltenham, Balgowlah, Hurstville (1897), Flemington, Richmond, Campbelltown (1885), Minnamurra Point, Bomaderry. CT: Robertson.**Habitat****Habitat:** Disturbed places.**Altitude:** 0–100 m**Annual rainfall:** 700–1400 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** With weeds of cultivation.**Substrate:** Clay soils on shale, medium nutrient, well-drained.**Exposure:****Conservation****Conservation:** Common weed of cultivation. Reported by Robert Brown to be introduced to Sydney by 1804 (Maiden 1909). Not invasive of bushland.***Teucrium argutum***

LAMIACEAE

Life history**Growth form:** Herb to 50 cm high with rhizomes, often scrambling; branches densely hairy.**Vegetative spread:** Suckering from rhizomes.**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** White to cream-coloured.**Fruit/seed:** Dry fruit, splits into 4, 1-seeded units.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC NWS CWS; Qld.**Distribution Sydney area:** Western Sydney.**Select locations:** CC: Casula, Nortons Basin.**Habitat****Habitat:** Hillside.**Altitude:** 0–100 m**Annual rainfall:** 800–1000 mm**Typical local abundance:** Rare.**Vegetation:** Woodland e.g. with *Eucalyptus moluccana*, *E. tereticornis*, *Angophora floribunda*, *Bursaria spinosa*, *Einadia hastata*.**Substrate:** Clay soil on Wianamatta Shale, medium nutrients, well-drained.**Exposure:****Conservation****Conservation:** Rare and inadequately conserved.

Teucrium corymbosum

LAMIACEAE

Forest Germander

Life history

Growth form: Herb to 1.5 m high, with simple leaves; branches covered with glands and short hairs.

Vegetative spread:

Longevity: Perennial.

Primary juvenile period:

Flowers: White to cream-coloured, October–April.

Fruit/seed: Dry brown capsule with 4, 1-seeded units, October–April..

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC CT CWS NWS SWP; Vic., Tas., S.A.

Distribution Sydney area: Widespread.

Select locations: CC: Culoul Range, Pulbah Is, Kogarah (1900), Helensburgh (1888), Albion Park, Grose Vale. CT: Mt Tomah, Mt Hay, Mt Wilson, Kanimbla Valley, Jenolan Caves, Wombeyan Caves.

Habitat

Habitat:

Altitude: 0–1000 m

Annual rainfall: 800–1400 mm

Typical local abundance: Rare–occasional.

Vegetation: Woodland e.g. with *Eucalyptus mannifera*, *E. dalrympleana*, *Acacia chalkerii*; moist open-forest e.g. with *Eucalyptus quadrangulata*, *E. muelleriana* or *E. deanei*, *Acacia parramattensis*.

Substrate: Sandy alluvial loam, reddish clay loam on limestone, rocky soil on basalt, medium to high nutrients, well-drained.

Exposure:

Conservation

Conservation: Appears to be rare, conservation status unknown.

Westringia eremicola

LAMIACEAE

Slender Westringia

Life history

Growth form: Shrub to 1.5 m high, with leaves in whorls of 3 or rarely 4.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Lilac, mauve or purple, rarely white, throughout the year.

Fruit/seed: Dry fruit, splits into 4, 1-seeded units.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: SC CC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., S.A.

Distribution Sydney area: Widespread but localised.

Select locations: CC: Kenthurst CT: Hilltop, Tallowa Dam, Bathurst, Wombeyan Caves, Abercrombie Caves.

	Habitat
Habitat: Hillsides, stony places.	
Altitude: 0–800 m	Annual rainfall: 600–1000 mm
Typical local abundance: Frequent.	
Vegetation: Woodland e.g. with <i>Eucalyptus dwyeri</i> , <i>E. goniocalyx</i> , <i>Acacia doratoxylon</i> , <i>Acacia vestita</i> , <i>Stellaria pungens</i> .	
Substrate: Dark brown gravelly loam on granite, also on limestone, quartzite, shale, low to medium nutrients.	
Exposure:	
	Conservation
Conservation: Conservation status unknown.	

<i>Westringia fruticosa</i>	LAMIACEAE
Coastal Rosemary	
	Life history
Growth form: Shrub to 1.5 m high, with leaves mostly in whorls of 4.	
Vegetative spread: Prostrate stems take root (L.McD.).	
Longevity:	
Primary juvenile period:	
Flowers: White with purplish or brown dots, throughout the year, with peak in September.	
Fruit/seed: Dry fruit, splits into 4, 1-seeded units, throughout the year.	
Dispersal, establishment & growth:	
Fire response:	
Interaction with other organisms: Foodplant of moth larvae <i>Myriotis ptousalis</i> (Common 1990).	
	Distribution
Status/origin: Native. Commonly cultivated, very easily grown from cuttings (L.McD.) and frequently used in foreshore plantings.	
Botanical subregions: NC CC SC ?CT; LHI.	
Distribution Sydney area: Coastline.	
Select locations: CC: Catherine Hill Bay, Terrigal, Barrenjoey, Manly, Bradleys Head, Bondi, La Perouse, Garie, Oatley (1902), Austinmer, Bass Point, Kiama, Stack Island.	
	Habitat
Habitat: Ocean and harbour foreshores, often on exposed cliffs.	
Altitude: 0–50 m	Annual rainfall: 1200–1600 mm
Typical local abundance: Frequent.	
Vegetation: Windswept coastal shrubland e.g. with <i>Melaleuca armillaris</i> , <i>Aotus ericoides</i> , <i>Lomandra longifolia</i> ; stunted open-forest e.g. with <i>Eucalyptus botryooides</i> ; grassland e.g. with <i>Themeda australis</i> (M. Robinson pers. comm.).	
Substrate: Shallow sandy soil on sandstone interbedded with shale, low to medium nutrients. Bumbo Latite Member, Budgong Sandstone in Illawarra (M. Robinson pers. comm.).	
Exposure: Exposed to coastal salt spray.	
	Conservation
Conservation: Probably adequately conserved though threatened by grazing in Illawarra (M. Robinson pers. comm.).	

Westringia longifolia

LAMIACEAE

Life history**Growth form:** Shrub 1–3 m high, with leaves in whorls of 3.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** White to pale mauve with purple to light brown dots, at any time of year, peak August–September.**Fruit/seed:** Dry fruit, splits into 4, 1-seeded units.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC CT NWS CWS; Qld.**Distribution Sydney area:** Mainly Woronora Plateau.**Select locations:** CC: Wheeny Creek, Ingleburn, Campbelltown, Douglas Park, Thirlmere, Bargo River. CT: Mittagong, Mt Jellere.**Habitat****Habitat:** Near creeks and rivers.**Altitude:** 0–800 m**Annual rainfall:** 800–1100 mm**Typical local abundance:** Frequent.**Vegetation:** Dry open woodland e.g. with *Eucalyptus tereticornis*, *Allocasuarina verticillata*; shrubland e.g. with *Allocasuarina littoralis*, *Pultenaea flexilis*.**Substrate:** Sandy soil on sandstone outcrops and colluvium, clay loam on trachyte, low nutrients, well-drained.**Exposure:****Conservation****Conservation:** Vulnerable in Western Sydney (Benson & McDougall 1991).***Cassytha glabella* forma *glabella***

LAURACEAE

Devil's Twine

Life history**Growth form:** Perennial twiner, partly parasitic on trees or shrubs, adult plants lack soil connection contacting hosts by means of haustoria (absorbing organs).**Vegetative spread:****Longevity:** Indefinite (D. Keith pers. comm.).**Primary juvenile period:** Primary juvenile period 2–3 years (D. Keith, P. Kubiak pers. comm.).**Flowers:** July–April.**Fruit/seed:** Succulent fruit, 4–6 mm long, July–November.**Dispersal, establishment & growth:** Diaspore: vertebrate-dispersed (French & Westoby 1996), possibly spread by birds. No dormancy (D. Keith pers. comm.). Germinates without treatment in soil, the roots later disappearing after host haustoria have developed, seeds will germinate under adults. Main recruitment after fire (D. Keith pers. comm.).**Fire response:** Killed (Fox 1988). Killed by high intensity fire (1/94) at Lane Cove, seedlings close to peak of post-fire fruiting in less than 3 years (P. Kubiak pers. comm.).**Interaction with other organisms:** Has very little chlorophyll; dependent on various host plants, usually perennials (McLuckie 1924). Single stem may parasitise many different species. Host plants include *Lomandra longifolia*, *Leptospermum parvifolium*. Flowers visited by honey bee *Apis mellifera*, probably for nectar (P. Kubiak pers. comm.). Foodplant of moth caterpillars *Hecatesia fenestrata* (Coupar & Coupar 1992) and *Eucyclodes buprestaria* (Common 1990).

	Distribution
Status/origin: Native.	
Botanical subregions: NC CC SC CT; Qld, Vic., Tas., S.A., W.A.	
Distribution Sydney area: Coast to Lower Blue Mountains.	
Select locations: CC: Putty, Gosford, Kurrajong, Richmond, Mt Colah, Hornsby, Pennant Hills, St Ives, Dee Why Lagoon, Rose Bay, Rockdale, Minto.	
	Habitat
Habitat: Shrubby open-forest and woodland.	
Altitude: 0–400 m Annual rainfall: 900–1400 mm	
Typical local abundance: Frequent–occasional.	
Vegetation: Eucalypt open-forest e.g. with <i>Eucalyptus piperita</i> , <i>Angophora costata</i> , <i>Allocasuarina littoralis</i> ; heath with e.g. <i>Corymbia gunnifera</i> , <i>Angophora hispida</i> .	
Substrate: Sandy clay soils on sandstone, often poorly-drained, low nutrients.	
Exposure: Full sun to light shade.	
	Conservation
Conservation: Probably adequately conserved.	

Cassytha melantha

LAURACEAE

Devil's Twine

	Life history
Growth form: Perennial twiner, partly parasitic on trees or shrubs, adult plants lack soil connection contacting hosts by means of haustoria (absorbing organs).	
Vegetative spread: No.	
Longevity: ?20 years.	
Primary juvenile period:	
Flowers: Spring	
Fruit/seed: Globular, succulent, 10–15 mm diam., green, drying black January–May.	
Dispersal, establishment & growth: Diaspore: fruit, germinates without treatment in soil, the roots later disappearing after host haustoria have developed, seeds will germinate under adults.	
Fire response: Probably killed as adult plants lack soil connection.	
Interaction with other organisms: Possesses little chlorophyll and is dependent absolutely on its hosts. No particular host specificity but generally perennials (McLuckie 1924). Single stem may parasitise many different species.	

	Distribution
Status/origin: Native.	
Botanical subregions: CT ST NWS SWS SWP SFWP; Vic., Tas., S.A., W.A.	
Distribution Sydney area: Upper Blue Mountains.	
Select locations: CT: Marrangaroo, Clarence, Bell, Wombeyan Caves.	
	Habitat
Habitat:	
Altitude: 600–1000 m Annual rainfall: 700–1100 mm	
Typical local abundance:	
Vegetation:	
Substrate:	
Exposure:	
	Conservation
Conservation: Only 4, mainly old collections in Sydney area, does not appear to be common. Conservation status unknown.	

Cassytha pubescens**LAURACEAE**

Devil's Twine

Life history

Growth form: Perennial twiner, partly parasitic on trees or shrubs, adult plants lack soil connection contacting hosts by means of haustoria (absorbing organs).

Vegetative spread:

Longevity:

Primary juvenile period: 3–4 years.

Flowers: Small whitish, mainly August–December.

Fruit/seed: Succulent, hairy, berry-like fruit 8–10 mm., mainly September–November.

Dispersal, establishment & growth: Diaspore: fleshy fruit, vertebrate-dispersed, fruit and seed not particularly attractive to ants (French & Westoby 1996). Seeds germinate without treatment in soil, sometimes under adults, the roots later disappearing after host haustoria have developed. Growth rate quick. Coloniser.

Fire response: Killed, seedlings recorded less than 1 year after fire (Purdie 1977), less than 8 months after high intensity fire (1/94) at Lane Cove, with immature fruit in 3 years (P. Kubiak pers. comm.).

Interaction with other organisms: Possesses little chlorophyll and is dependent absolutely on its hosts. No particular host specificity but generally perennials (McLuckie 1924). Single stem may parasitise many different species including *Pultenaea flexilis*, *Persoonia levis*, *Dillwynia retorta*, *Leptospermum trinervium*, *Cassinia arcuata*. Small dark native bee fed on flower (P. Kubiak pers. comm.). Foodplant of moth caterpillars *Hecatesia fenestrata* (Coupar & Coupar 1992) and *Eucyclodes buprestaria* (Common 1990). Fruit palatable to humans (L.McD.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWS NWP; Qld, Vic., S.A., N.Z.

Distribution Sydney area: Widespread.

Select locations: CC: Howes Valley, Boudi, Cheltenham, Manly, Cronulla, Belmore, St Marys, Campbelltown, Thirlmere, Springwood. CT: Mittagong, Cambewarra, Wentworth Falls, Lewis Ponds.

Habitat

Habitat: Levee banks. Ridges, slopes, hind-dunes, forest (M. Robinson pers. comm.).

Altitude: 0–1000 m **Annual rainfall:** 800–1400 mm

Typical local abundance: Frequent–occasional.

Vegetation: Heath and open-forest e.g. with *Eucalyptus piperita*, *Corymbia gumuifera*, *C. eximia*, *Eucalyptus haemastoma*, *Banksia serrata*; rainforest margins (M. Robinson pers. comm.).

Substrate: Sandy soil on sandstone, metasediments, low nutrient soils, well-drained. Latite, Quaternary alluvium in Illawarra (M. Robinson pers. comm.).

Exposure: Full sun to light shade (M. Robinson pers. comm.).

Conservation

Conservation: Probably adequately conserved.

Cinnamomum camphora* **LAURACEAE**

Camphor Laurel

Life history

Growth form: Large spreading tree, bark rough, greyish-brown with prominent vertical cracks. Leaves alternate, upper surface glossy green, lower surface glaucous; scent of camphor when crushed.

Vegetative spread: No.

Longevity: More than 100 years (500 years in native habitat) (Firth 1986).

Primary juvenile period: 7 years (Firth 1986).

Flowers: Small, white, October.

Fruit/seed: Fleshy, edible black berry, 10 mm diam., with a single seed 5 mm diam., matures April–June. More than 100 000 fruits produced on mature tree (Firth 1986).

Dispersal, establishment & growth: Diaspore: fruits, dispersed by birds and animals e.g. currawongs, foxes and possums (Smith & Waterhouse 1988), fruit reported from pellets of Currawongs (Buchanan 1989a). Also dispersed by water; seed viability usually 70% in first year decreasing rapidly in the second year, with some seeds remaining viable for 3 years; germination over 4–20 weeks, facilitated by bird ingestion possibly removing inhibitors in fruit, or water possibly removing inhibitors in seedcoat; seedlings do not grow quickly until root system 1 year old (Firth 1986). Establishes in moist sheltered, often low light sites. Seedlings frost-sensitive (Firth 1990). Major canopy leaf drop and immediate replacement with new growth in spring possibly accentuated by dry conditions (September 1994).

Fire response: Roots reshoot after burning (Buchanan 1981), flowering in less than 2 years after high intensity fire (1/94) at Lane Cove (P. Kubiak pers. comm.). Establishes in forest sites in absence of fire.

Interaction with other organisms: Fruit eaten by flock pigeons, Magpies, Figbirds, Olivebacked Orioles, Blue-faced Cuckoo Shrikes (Firth 1986). Evidence of allelopathy, reducing growth of other plants (Firth 1990). Larvae of Common Red-eye butterfly *Chaetocneme beata* found between joined leaves (Common & Waterhouse 1982). Foodplant of butterfly caterpillar *Graphium macleayanum* (Coupar & Coupar 1992) and moth larvae *Isotenes miserana* (Common 1990). Foodplant of White-headed Pigeon (M. Robinson pers. comm.). Fruits of Lauraceae species are not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds (Eby 1995).

Distribution

Status/origin: Exotic, native to China and Japan. Introduced to Australia 1822 (Firth 1986), by 1900–20 widely established in Sydney gardens and public places. Camphor is obtained by distillation; timber used for clothes storage boxes, turnery etc. (Harden 1990).

Botanical subregions: NC CC; Qld, Asia.

Distribution Sydney area: Widespread on coast.

Select locations: CC: Wyong, Mangrove Creek, Epping (1946), Dalrymple Hay NR, Northbridge, Warriewood (P. Kodala p.c.), Wollongong, Minnamurra (M. Robinson p.c.).

Habitat

Habitat: Disturbed gullies.

Altitude: 0–200 m **Annual rainfall:** 1000–1600 mm

Typical local abundance: Frequent.

Vegetation: Open-forest e.g. with *Eucalyptus dennei*, *E. saligna*, *E. paniculata*, *Augophora floribunda*; along creeks e.g. with *Schizoueria ovata*, *Calliconna serratifolia*; and *Casuarina cunninghamiana* (M. Robinson pers. comm.).

Substrate: Sandy loams from shale, sandstone, alluvium, medium nutrients, well-drained.

Exposure: Full shade–full sun.

Conservation

Conservation: Extensively naturalised, particularly over the past 30 years, in coastal areas on better soils where it often hinders the regeneration of native rainforest species (Harden 1990) and along gullies generally associated with catchment disturbance. Tendency to form monocultures, excluding native vegetation. Roots reshoot after poisoning, cutting or burning (Buchanan 1981). Expanding rapidly in Illawarra (M. Robinson pers. comm.).

Cinnamomum oliveri

LAURACEAE

Oliver's Sassafras

Life history

Growth form: Medium-sized to large tree, with all parts strongly aromatic, opposite leaves. Bark grey or brown with a thin corky layer; branchlets smooth, green.

Vegetative spread: No.

Longevity: Long-lived (M. Robinson pers. comm.).

Primary juvenile period:

Flowers: Cream, fragrant, October–November. Flowering sporadic and opportunistic, does not flower each year (R. Payne pers. comm.).

Fruit/seed: Black oval fruit 12 mm long, seated in a ribbed receptacle, with one seed, ripe March. 2300 fruits per kg (Floyd 1989). The fruits are often galled and irregular in shape 2–5 cm diam., yellowish whitish with a powdery fungal coating, aromatic (Harden 1990). Prolific but infrequent fruiting e.g. at 7 year intervals (A. Bofeldt pers. comm.).

Dispersal, establishment & growth: Diaspore: fruit, probably bird-dispersed. Fresh seed germinates after flesh has been removed but has very short longevity due to deterioration on drying out (Floyd 1989). Seed with short viability, germination 2–6 weeks (A. Bofeldt pers. comm.).

Fire response: Killed (A. Bofeldt pers. comm.).

Interaction with other organisms: Fruit eaten by Green Catbird, Pied Currawong, White-headed Pigeon (Floyd 1989). Fruits of Lauraceae species are not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds (Eby 1995).

Distribution

Status/origin: Native.

Botanical subregions: NC CC; Qld.

Distribution Sydney area: Coast.

Select locations: CC: Gosford, Mt Keira, Minnamurra Falls, Berry.

Habitat

Habitat: Gully rainforest, escarpment slopes.

Altitude: 0–400 m

Annual rainfall: 1200–1600 mm

Typical local abundance: Rare–frequent.

Vegetation: Rainforest e.g. with *Podocarpus elatus* (at Gosford); riverine rainforest, warm temperate rainforest, subtropical rainforest, and littoral rainforest (A. Bofeldt & M. Robinson pers. comm.).

Substrate: Moist clay soils from shales, volcanics, medium nutrients. Soil pH 4.0–4.2 with high aluminium component (R. Payne pers. comm.). Coal Measures, Narrabeen Series, Budgong Sandstone, Bumbo Latite Member, Blow Hole Latite Member in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Full shade (A. Bofeldt pers. comm.).

Conservation

Conservation: Conservation status unknown. A few plants conserved in gully rainforest at Gosford, Wambina Road NR; in Matcham Range gullies and Ourimbah Creek gullies where the rainfall is high, but not found in Bouddi at Mt Avoca (R. Payne pers. comm.), common in Budderoo NP and Minnamurra NP (A. Bofeldt & M. Robinson pers. comm.). Southern geographical limit at Berry.

Cryptocarya glaucescens

LAURACEAE

Jackwood

Life history**Growth form:** Medium-sized tree, to 30 m high, sometimes buttressed.**Vegetative spread:** No (A. Bofeldt pers. comm.).**Longevity:** Long-lived (A. Bofeldt pers. comm.).**Primary juvenile period:****Flowers:** Yellowish, October–November.**Fruit/seed:** Black, shiny fleshy fruit, 12–20 mm diam., light brown wrinkled seed 9–14 mm long, mature March–December. Fresh fruits 630–650/kg, dried seeds 2800–3500/kg, (Floyd 1989).**Dispersal, establishment & growth:** Diaspore: fleshy fruit, vertebrate-adapted for dispersal (Westoby et al. 1990). Fresh seed does not germinate until the flesh has been removed (Floyd 1989), germination 3–6 weeks (A. Bofeldt pers. comm.).**Fire response:** Resprouted from base, St Albans 1994 (E. Ashby pers. comm.). Trees at Bola Creek showed bark damage and deterioration 3–4 years after fire.**Interaction with other organisms:** Fruit eaten by Topknot Pigeon (Floyd 1989). Fruits of Lauraceae species are not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds (Eby 1995). Moth larvae *Plectophila discalis* feed in shelter formed between leaves (Common 1990).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT; Qld.**Distribution Sydney area:** Coastal ranges.**Select locations:** CC: Watagan, Yarramalong, Holgate, Fox Valley, Otford, Mt Keira, Macquarie Pass, Cambewarra Mtn, Brogers Creek, Berry. CT: Robertson.**Habitat****Habitat:** Gullies and sheltered sites, escarpment slopes.**Altitude:** 0–700 m**Annual rainfall:** above 1200 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Warmer rainforest e.g. with *Doryphora sassafras* and moist open-forest e.g. with *Eucalyptus pilularis*, *E. saligna*; more rarely mixed warm-temperate/cool-temperate rainforest on tablelands (P. Kodala pers. comm.).**Substrate:** Loamy soils from alluvium, shales, basalt, sand and sandstone, medium to high nutrients, well-drained.**Exposure:** Sheltered situations, mid to deep shade.**Conservation****Conservation:** Well-conserved in Illawarra e.g. in Budderoo NP, Macquarie Pass NP, Morton NP (A. Bofeldt pers. comm.), conservation status elsewhere unknown.

Cryptocarya microneura**LAURACEAE**

Murrogun

Life history

Growth form: Small to large tree, with young growth covered in fawn hairs. Branchlets greenish black, smooth (Floyd 1989).

Vegetative spread:

Longevity: Long-lived (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Yellowish, hairy, September–May. Flowering sporadic and opportunistic, does not flower each year (R. Payne pers. comm.).

Fruit/seed: Succulent black fruit 12 mm long with single seed 6 mm long, 1475 seeds per kg (Floyd 1989), ripe December–July.

Dispersal, establishment & growth: Diaspore: fleshy fruit, vertebrate-dispersed (Westoby et al. 1990), fresh seed germinates after flesh has been removed (Floyd 1989), germination 4–8 weeks (A. Bofeldt pers. comm.).

Fire response: Possibly killed (A. Bofeldt pers. comm.).

Interaction with other organisms: Fruit eaten by Topknot Pigeon (Floyd 1989). Fruits of Lauraceae species are not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds (Eby 1995).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC; Qld.

Distribution Sydney area: Coast.

Select locations: CC: Wyong, Gosford, Careel Bay, Clifton, Austinmer, Albion Park, Bass Point, Jamberoo.

Habitat

Habitat: Coastal rainforest, escarpment slopes, gullies and foothills.

Altitude: 0–200 m **Annual rainfall:** 1200–1600 mm

Typical local abundance: Frequent.

Vegetation: Warm temperate rainforest; dry rainforest e.g. with *Pisonia umbellifera*, *Streblus brunonianus*, *Dendrocnide* sp. and *Syzygium* sp., littoral rainforest, subtropical rainforest; also in *Eucalyptus robusta* swamp forest.

Substrate: Moist dark loam on volcanics, sandy clay on Narrabeen formation, medium to high nutrients. Soil pH 4.0–4.2 with high aluminium component (R. Payne pers. comm.). Latite and sand in Illawarra (A. Bofeldt pers. comm.).

Exposure: Shade tolerant (A. Bofeldt pers. comm.).

Conservation

Conservation: Conserved in Wambina Road NR. often found in gullies in Gosford but as distance from the coast increases it tends to be replaced by *Cryptocarya glaucescens* (R. Payne pers. comm.). Well conserved in Illawarra (A. Bofeldt pers. comm.), conservation status elsewhere unknown.

Cryptocarya obovata

LAURACEAE

Pepperberry

Life history

Growth form: Large tree to 40 m high, often buttressed at base, branchlets covered in brown velvety down (Floyd 1989).

Vegetative spread: No.

Longevity:

Primary juvenile period:

Flowers: Whitish, hairy. Flowering sporadic and opportunistic, does not flower each year (R. Payne pers. comm.).

Fruit/seed: Black globose ribbed fruit 12 mm diam., ripe March–May. 1200 seeds per kg (Floyd 1989).

Dispersal, establishment & growth: Diaspore: fruit. Germination of fresh seed, after removal of flesh, began after 6 months, with 50% germination after 8 months (Floyd 1989).

Fire response:

Interaction with other organisms: Fruit eaten by Figbird, Rose-crowned Fruit-dove, Topknot Pigeon, Wompoo Fruit-dove (Floyd 1989). Fruits of Lauraceae species are not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds (Eby 1995).

Distribution

Status/origin: Native.

Botanical subregions: NC CC; Qld.

Distribution Sydney area: Jilliby–Ourimbah.

Select locations: CC: Jilliby, Ourimbah.

Habitat

Habitat: Riverbank rainforest.

Altitude: 0–50 m **Annual rainfall:** 1200 mm

Typical local abundance: Very rare.

Vegetation: Subtropical rainforest (riparian) e.g. with *Gmelina leichhardtii*, as dominant, other species include *Cryptocarya glaucescens*, *Guioa semiglauca*, *Melodinus australis*, *Palmeria scandens*, *Adiantum silvaticum*.

Substrate: Deep quartz, sandy alluvium, moist. Soil pH 4.0–4.2 with high aluminium component (R. Payne pers. comm.).

Exposure:

Conservation

Conservation: Jilliby–Ourimbah is southern geographical limit; plants at Ourimbah are threatened by infestation of *Anredera cordifolia** and *Cardiospermum grandifolium** (R. Payne Herbarium note). Not conserved.

Cryptocarya rigida

LAURACEAE

Forest Maple

Life history

Growth form: Shrub to small tree to 10 m; young growth covered with pale brown hairs.

Vegetative spread: Suckers (A. Bofeldt pers. comm.).

Longevity:

Primary juvenile period:

Flowers: Cream or pale green, hairy, June–October. Flowering sporadic and opportunistic, does not flower each year (R. Payne pers. comm.).

Fruit/seed: Pointed, black, egg-shaped fleshy fruit 20 mm long with a single seed 15–20 mm long, ripe January–May. 1800 seeds per kg (Floyd 1989).

Dispersal, establishment & growth: Diaspore: fruit, probably bird-dispersed. Fresh seed germinates after flesh has been removed (Floyd 1989), short viability with germination in 4–8 weeks (A. Bofeldt pers. comm.).

Fire response: Seedlings found in recently burnt areas of Bouddi NP (Little Beach), presumably seeds germinated after being dropped by birds; the area where it occurs is very moist (R. Payne pers. comm.).

Interaction with other organisms: Fruit eaten by Rose-crowned Fruit-dove (Floyd 1989). Fruits of Lauraceae species are not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds (Eby 1995).

Distribution

Status/origin: Native.

Botanical subregions: NC CC; Qld.

Distribution Sydney area: Gosford–Wyong.

Select locations: CC: Watagan SF, Ourimbah, Lisarow, Holgate, Bouddi.

Habitat

Habitat: Creekbanks, slopes.

Altitude: 0–200 m **Annual rainfall:** 1200–1400 mm

Typical local abundance: Rare–occasional.

Vegetation: Gallery rainforest e.g. with *Ceratopetalum apetalum*, *Doryphora sassafras*, *Callicoma serratifolia*; less commonly open-forest e.g. with *Eucalyptus pipularis*, *E. saligna*, *Syncarpia glomulifera*, *Rhodamnia rubescens*, *Gmelia leichhardtii*.

Substrate: Moist clay soil on Narrabeen Series, alluvium, medium nutrients. Soil pH 4.0–4.2 with high aluminium component (R. Payne pers. comm.).

Exposure: Sheltered sites. Shade tolerant (A. Bofeldt pers. comm.).

Conservation

Conservation: Very rare in Sydney area, Bouddi is southern geographical limit (R. Payne pers. comm.), conservation status unknown.

Endiandra discolor

LAURACEAE

Rose Walnut, Domatia Tree

Life history

Growth form: Medium-sized to large buttressed tree; young growth covered with fawn hairs.

Vegetative spread: No.

Longevity: Long-lived (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Creamy green, sweetly scented, October–November (Floyd 1989). Flowering sporadic and opportunistic, does not flower each year (R. Payne pers. comm.).

Fruit/seed: Shiny black fruit 20 mm long, with green flesh and single seed 15–20 mm long, ripe March–April. 470 fruit and 750 seed per kg (Floyd 1989).

Dispersal, establishment & growth: Diaspore: fruit, probably bird-dispersed. Fresh seed germinates after flesh has been removed.

Fire response: Possibly killed (A. Bofeldt pers. comm.).

Interaction with other organisms: Eaten by Catbird, Rose-crowned Fruit-dove, Superb Fruit-dove, Topknot Pigeon, Wompoo Fruit-dove (Floyd 1989). Fruits of Lauraceae species are not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds (Eby 1995).

Status/origin: Native.	Distribution
Botanical subregions: NC CC; Qld.	
Distribution Sydney area: Gosford–Wyang.	
Select locations: CC: Cooranbong, Yarramalong, Narrara, Gosford, Matcham, Bouddi.	
Habitat: Gullies, along streams, moist slopes.	Habitat
Altitude: 0–200 m Annual rainfall: 1200–1400 mm	
Typical local abundance: Rare–frequent.	
Vegetation: Gully rainforest e.g. with <i>Ceratopetalum apetalum</i> , <i>Doryphora sassafras</i> , <i>Cryptocarya glaucescens</i> , <i>Glochidion ferdinandi</i> .	
Substrate: Moist clay loams on Narrabeen shales and sandy clay alluvium, medium nutrients. Soil pH 4.0–4.2 with high aluminium component (R. Payne pers. comm.).	
Exposure: Grows along stream banks and sometimes in exposed situations (R. Payne pers. comm.), shade-tolerant (A. Bofeldt pers. comm.).	
Conservation: Bouddi is southern geographical limit (Harden 1990). Conserved in Wambina Road NR (R. Payne pers. comm.), adequacy of conservation unknown.	Conservation

Endiandra sieberi

LAURACEAE

Hard Corkwood

Life history

Growth form: Small to medium-sized tree with hard corky bark.
Vegetative spread: No.
Longevity: Long.
Primary juvenile period:
Flowers: Pinkish cream to yellowish, June–October.
Fruit/seed: Purplish-black, fleshy egg-shaped fruit 2–3 cm long enclosing a single seed 25–30 mm long, ripe September–March. 140–230 fruits and 270–460 seeds per kg (Floyd 1989).
Dispersal, establishment & growth: Diaspore: fruit, probably bird-dispersed. 18% germination of fresh seed between 119 and 394 days, after removal of flesh (Floyd 1989).
Fire response: Resprouts above ground level (Fox 1988), from base after high-intensity fire (1/94) at Narrabeen (P. Koubiak pers. comm.).
Interaction with other organisms: Food plant of Eastern Flat butterfly *Netrocoryne repandra repandra* (Common & Waterhouse 1982). Fruit eaten by Topknot Pigeon, White-headed Pigeon (Floyd 1989). Main food source of Topknot Pigeon in Wyrabalong NP (R. Payne pers. comm.). Fruits of Lauraceae species are not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds (Eby 1995).

Distribution

Status/origin: Native.
Botanical subregions: NC CC SC; Qld.
Distribution Sydney area: Coast.
Select locations: CC: North Entrance Peninsula, Avoca Beach, Wyong, Wondabyne, Katandra, Deep Creek, North Head, La Pouse, Kurnell, Stanwell Park, Shellharbour.

Habitat

Habitat: Littoral rainforest.
Altitude: 0–300 m **Annual rainfall:** 1200–1400 mm
Typical local abundance: Occasional.
Vegetation: Littoral rainforest e.g. with *Acmena smithii*, *Gnioa semiglaucula*, *Syzygium pauciculatum*; and eucalypt open-forest.
Substrate: Sandy soil on sandstone and coastal sand dunes such as Quaternary Sands, loose quartz unconsolidated sands, low–medium nutrients. Bass Point Sandstone in Illawarra (A. Bofeldt & M. Robinson pers. comm.).
Exposure: Does not grow well in exposed conditions (R. Payne pers. comm.).

Conservation

Conservation: Forms main component of littoral rainforest in Wyrabalong NP (R. Payne pers. comm.). Conservation status not known.

Litsea reticulata

LAURACEAE

Bolly Gum

Life history

Growth form: Tree to 25 m with smooth bark marked by oval depressions. Buttressed or flanged at base in large trees.

Vegetative spread: No.

Longevity: Long-lived (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Male and female flowers on separate trees, cream or green with pink glands, scented, May–July (Floyd 1989). Flowering sporadic and opportunistic, does not flower each year (R. Payne pers. comm.).

Fruit/seed: Purple to black fleshy fruit 13 mm long with single oval seed 11 mm long, ripe November–April. 1300 dried fruits per kg (Floyd 1989).

Dispersal, establishment & growth: Diaspore: fruit, probably bird-dispersed. Fresh seed germinates after flesh has been removed (Floyd 1989), short viability 1–3 months, germination 2–6 weeks (A. Bofeldt pers. comm.).

Fire response: Killed (A. Bofeldt pers. comm.).

Interaction with other organisms: Fruit eaten by Green Catbird, Topknot Pigeon, Wompoo Fruit-dove, White-headed Pigeon (Floyd 1989). Fruits of Lauraceae species are not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds (Eby 1995). Moth larvae *Isotenes miserana* recorded from fruit (Common 1990).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC; Qld.

Distribution Sydney area: Coastal, Gosford, Illawarra.

Select locations: CC: North Entrance Peninsula, Mt Katandra, Bouddi, Mt Keira, Minnamurra Falls, Comerong Island.

Habitat

Habitat: Rainforest.

Altitude: 0–400 m

Annual rainfall: 1200–1600 mm

Typical local abundance: Frequent–occasional.

Vegetation: Warm temperate, subtropical, littoral and gully rainforest e.g. with *Glochidion ferdinandi*, *Acmena smithii*, *Cupaniopsis anacardioides*.

Substrate: Moist sandy loam on shales, sandstone basalt and alluvium, medium nutrients. Soil pH 4.0–4.2 with high aluminium component (R. Payne pers. comm.). Well-drained, Budgong Sandstone, Bumbo Latite, Bass Point Sandstone in Illawarra (A. Bofeldt pers. comm.).

Exposure: Sheltered sites. Full shade (A. Bofeldt pers. comm.).

Conservation

Conservation: Conserved in Wambina Road NR but very uncommon in Gosford–Wyong area (R. Payne pers. comm.), reported from Brisbane Water NP, Macquarie Pass NP, Illawarra SRA (A. Bofeldt & M. Robinson pers. comm.).

Neolitsea dealbata

LAURACEAE

White Bolly Gum

Life history**Growth form:** Shrub or tree to 12 m high; young branchlets hairy.**Vegetative spread:** No.**Longevity:****Primary juvenile period:****Flowers:** Cream to pale brown, fragrant, February–June (Floyd 1989).**Fruit/seed:** Fleshy black globose fruit 8 mm diam. with single round seed 5 mm diam., ripe February–July, 5800 seeds per kg (Floyd 1989), mature March (at Gosford R. Payne pers. comm.).**Dispersal, establishment & growth:** Diaspore: fruit, probably bird-dispersed. Fresh seed germinates after flesh has been removed (Floyd 1989), short viability, germination 3–5 weeks (A. Bofeldt pers. comm.).**Fire response:** Probably killed (A. Bofeldt pers. comm.).**Interaction with other organisms:** Fruit eaten by Cuckoo-dove, Green Catbird, Rose-crowned Fruit-dove, Superb Fruit-dove, Topknot Pigeon, Wompoo Fruit-dove, White-headed Pigeon (Floyd 1989). Fruits of Lauraceae species are not eaten by Flying Foxes possibly because they contain high levels of secondary chemical compounds (Eby 1995).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC; Qld.**Distribution Sydney area:** Mainly Gosford area. Also Illawarra (Mt Keira to Bulli) (Floyd 1989).**Select locations:** CC: Wheeny Creek, Wyong Creek, Strickland SF, Mount Avoca, Mt Keira.**Habitat****Habitat:** Understorey in rainforest.**Altitude:** 0–300 m**Annual rainfall:** 1000–1600 mm**Typical local abundance:** Frequent–rare.**Vegetation:** Warm temperate/subtropical rainforest e.g. with *Doryphora sassafras*, *Ceratopetalum apetalum*, *Backhousia myrtifolia*, *Sloanea australis*; margins of eucalypt forest.**Substrate:** Moist sandy soils on Narrabeen strata and colluvium, medium nutrients, well-drained. Soil pH 4.0–4.2 with high aluminium component (R. Payne pers. comm.).**Exposure:** Does not grow well in exposed conditions (R. Payne pers. comm.), full shade (A. Bofeldt pers. comm.).**Conservation****Conservation:** Common in Gosford rainforests, conserved in Wambina Road NR (R. Payne pers. comm.). Regionally rare in Illawarra region (Mills 1988), Mt Keira is the southern geographical limit. Conservation status elsewhere unknown. Records for *Neolitsea australiensis* in the Ourimbah area have been redetermined as *Neolitsea dealbata*. *Neolitsea australiensis* occurs north from Karuah.

Utricularia australis

LENTIBULARIACEAE

Yellow Bladderwort

Life history

Growth form: Floating aquatic carnivorous herb without roots; divided leaves with traps that suck in water potentially containing organisms for food.

Vegetative spread: Stoloniferous. Rhizoids present (R. Jobson pers. comm.).

Longevity: Perennial. Turions formed in cool months (R. Jobson pers. comm.).

Primary juvenile period:

Flowers: Yellow with reddish brown lines and spots on darker lower lip, presumably insect-pollinated (Juniper et al. 1989), December–February (R. Jobson pers. comm.).

Fruit/seed: Capsule, with numerous seeds, 0.5 mm long, narrowly winged on all edges (R. Jobson pers. comm.). Seed production opportunistic and seeds rarely develop.

Dispersal, establishment & growth: Diaspore: seeds, though rarely produced, may disperse via attachment to feathers and muddy feet of waterbirds, also water-dispersed (R. Jobson pers. comm.).

Fire response:

Interaction with other organisms: Mucilage secretions on trap door contain bacilli bacteria which may attract bacteriophagous micro- and macro-fauna prey; trap surfaces provide substrate for algae which may attract algivorous prey (R. Jobson pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC CT ST SWS SWP; Vic., Tas., N.T., S.A., W.A., N.Z., N.G., Eur, trop. & temp. Asia, trop & southern Afr.

Distribution Sydney area: Widespread.

Select locations: CC: Howes Swamp, Cattai, Botany Swamps (1957), Audley, Albion Park, Thirlmere Lakes. CT: Wingecarribee Swamp.

Habitat

Habitat: Still or slowly flowing water.

Altitude: 0–700 m

Annual rainfall: 800–1400 mm

Typical local abundance: Frequent–occasional.

Vegetation: Wetland e.g. with *Lepironia articulata*, *Philydrum lanuginosum*; and montane peatland e.g. with *Carex*.

Substrate: Open water, low to medium nutrients. pH 5.5–7 (R. Jobson pers. comm.).

Exposure: Full sun (R. Jobson pers. comm.).

Conservation

Conservation: Very abundant in lagoons and backwaters of the Nepean River (R. Jobson pers. comm.). Conservation status unknown.

Utricularia biloba

LENTIBULARIACEAE

Moth Bladderwort

Life history

Growth form: Terrestrial or subaquatic perennial carnivorous herb without roots; stems modified to appear and function as roots, leaves and traps for capturing organisms for food.

Vegetative spread: Stoloniferous, some rhizoids present (R. Jobson pers. comm.).

Longevity: Perennial (R. Jobson pers. comm.).

Primary juvenile period:

Flowers: Dark blue-violet with 2 white streaks at base of lip, February–March. Probably self- or insect-pollinated (R. Jobson pers. comm.).

Fruit/seed: Globose capsule with ellipsoid seeds about 2 mm long (R. Jobson pers. comm.), usually numerous.

Dispersal, establishment & growth: Dispersed on feet of birds and water-dispersed (R. Jobson pers. comm.).

Fire response:

Interaction with other organisms: May be similar to *U. uliginosa* with mucilage glands and trichomes on trap surfaces contain bacilli bacteria that attract bacteriophagous crustaceans (Harpacticoids) (R. Jobson pers. comm., laboratory experiments & in situ observations).

Status/origin: Native.		Distribution
Botanical subregions: NC CC; Qld.		
Distribution Sydney area: Coast.		
Select locations: CC: Manly (1885), Jibbon Lagoon (1988).		
Habitat: Wet sand and shallow water in coastal heath.		Habitat
Altitude: 0–50 m	Annual rainfall: 1200 mm	
Typical local abundance: Occasional.		
Vegetation: Tussock grasses.		
Substrate: Very wet peaty soil and shallow water. Low to medium nutrients. pH 4.5–5.5 (R. Jobson pers. comm.).		
Exposure: Full sun to semi shade (R. Jobson pers. comm.).		
Conservation: Rare in Sydney region, ?possibly should be included on endangered species list (P. Adam pers. comm.). Very hard to find in Royal NP, the southern geographical limit, where it is extremely limited in distribution, with tiny dispersed colonies at Jibbon Lagoon; threatened by disturbance from deer populations digging up extensive patches of heath to get to flowing water beneath the surface (R. Jobson pers. comm.). Only other Sydney record, Manly, last collected 1885.		Conservation

Utricularia dichotoma

LENTIBULARIACEAE

Fairy Aprons

Growth form: Terrestrial perennial carnivorous herb with linear leaves and without roots; traps on stolons suck in water potentially containing organisms for food.		Life history
Vegetative spread: Stolons and rhizoids (R. Jobson pers. comm.).		
Longevity: Indefinite (D. Keith pers. comm.).		
Primary juvenile period:		
Flowers: Usually dark violet with yellow ridges on lip, at any time of year except June–July (Harden 1992), peak October–December. Presumably insect-pollinated (Juniper et al. 1989).		
Fruit/seed: Capsule, usually with numerous seeds, 0.5 mm long.		
Dispersal, establishment & growth: Recruitment mainly after fire (D. Keith pers. comm.).		
Fire response: Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).		
Interaction with other organisms: May be similar to <i>Utricularia uliginosa</i> with mucilage of glands and trichomes on trap surfaces containing bacilli bacteria that attract bacteriophagous crustaceans (Harpacticoids) (R. Jobson pers. comm. laboratory experiments & in situ observations).		

Status/origin: Native.		Distribution
Botanical subregions: NC CC SC NT CT ST NWS CWS SWS SWP NFWP; Qld, Vic., Tas., S.A., W.A.		
Distribution Sydney area: Widespread.		
Select locations: CC: Wyong, Somersby, La Perouse, Bulli, Richmond, Fitzroy Falls. CT: Katoomba, Clarence, Jenolan Caves, Oberon, Moss Vale. Wingecarribee Swamp (P. Kodala p.c.).		

Habitat: Damp or wet places.		Habitat
Altitude: 0–1000 m	Annual rainfall: 900–1400 mm	
Typical local abundance: Frequent.		
Vegetation: Wet places and sedgeswamp e.g. with <i>Gymnoschoenus sphaerocephalus</i> , <i>Xyris</i> , <i>Restio australis</i> , <i>Baeckea linifolia</i> , <i>Grevillea acanthifolia</i> .		
Substrate: Damp sandstone rocks, wet slopes and in shallow water, low nutrients, low NO ₃ , NH ₄ . Saturated soils but water usually moving, also on peaty substrates, on some cliffs exposed to heavy salt spray where seepage may prevent salinity build-up, but this is a fairly extreme habitat (P. Adam pers. comm.).		
Exposure: Full sun to light shade.		

Conservation: Occurrences in Botany Bay NP and other conservation areas (P. Adam pers. comm.), adequacy of conservation unknown.		Conservation
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Utricularia gibba

LENTIBULARIACEAE

Floating Bladderwort

Life history

Growth form: Submerged, unattached, aquatic perennial without roots, stems to 70 cm long, readily fragmenting. Submerged leaves form small traps for aquatic organisms.

Vegetative spread: Stoloniferous.

Longevity: Annual or perennial (R. Jobson pers. comm.).

Primary juvenile period: Minimum time to flowering from resprout less than 6 months?

Flowers: Yellow, January–March, but not every year in any one locality (Sainty & Jacobs 1981).

Fruit/seed: Capsule with small seeds, though seed production opportunistic and seeds rarely develop. Winged seeds c. 1 mm diam., 40–60 µg (R. Jobson pers. comm.).

Dispersal, establishment & growth: Dispersed by seed, water, probably in summer but mainly by fragmentation of individuals and turions or winter buds formed at branch ends (Sainty & Jacobs 1981). Summer growing, the plants photosynthesise but also derive a substantial nutrient supply from their traps (Sainty & Jacobs 1981). Difficult to germinate, possibly requires high levels of humic acid (R. Jobson pers. comm.).

Fire response:

Interaction with other organisms: Mucilage secretions on trap door contain bacilli bacteria which may attract bacteriophagous micro and macro-fauna prey; trap surfaces provide substrate for algae which may attract algivorous prey (R. Jobson pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC; Qld, N.T., N.Z., N.Cal., trop. regions, N & S Amer.

Distribution Sydney area: Coastal and riverine wetlands, rare.

Select locations: CC: Morisset, Mangrove Creek (1974), Longneck Lagoon (1969), Richmond (1992), Centennial Park, Coogee (R. Jobson p.c.), Marley Lagoon, Thirlmere Lakes.

Habitat

Habitat: Free-floating in freshwater lagoons, wetlands. Also rock crevice pools a few cm deep (at Coogee) (R. Jobson pers. comm.).

Altitude: 0–100 m **Annual rainfall:** 800–1200 mm

Typical local abundance: Frequent.

Vegetation: Low nutrient permanent or semi-permanent fresh swamps.

Substrate: Stationary or slow-moving water to several metres deep, usually floating within the top metre in acid lagoons, small lakes and swamps, low nutrients, fresh, acid pH. 5.5–6.5 pH (at Audley, Coogee, R. Jobson pers. comm.).

Exposure: Full sun.

Conservation

Conservation: Rare and poorly conserved. Vulnerable in Western Sydney (Benson & McDougall 1991). Very limited in Sydney Basin, not seen (summer) at Longneck Lagoon (R. Jobson pers. comm.).

Utricularia lateriflora

LENTIBULARIACEAE

Small Bladderwort

Life history

Growth form: Terrestrial perennial carnivorous herb without roots; stems modified to appear and function as roots, leaves and traps for capturing organisms for food.

Vegetative spread: Stolons and rhizoids.

Longevity: Indefinite (D. Keith pers. comm.).

Primary juvenile period:

Flowers: Pale lilac to mauve or violet with white or yellow spot at base of lip, presumably insect-pollinated (Juniper et al. 1989), flowers at any time of year.

Fruit/seed: Capsule, usually with numerous seeds, 0.25 mm diam. (R. Jobson pers. comm.).

Dispersal, establishment & growth: Dispersed by birds and water (R. Jobson pers. comm.).

Fire response: Resprouts (D. Keith pers. comm.). Numerous plants flowered within 8 months of high intensity fire (1/94) at Narrabeen (P. Kubiak pers. comm.).

Interaction with other organisms: Mucilage of glands and trichomes on trap surfaces contain bacilli bacteria that attract bacteriophagous crustaceans (Harpacticoids) (R. Jobson pers. comm., laboratory experiments & in situ observations).

Distribution**Status/origin:** Native.**Botanical subregions:** NC CC SC CT; Qld, Vic., Tas., S.A.**Distribution Sydney area:** Coast and Blue Mountains.**Select locations:** CC: Mt White, Terrey Hills, Narraweena (1983), Royal NP, Bulli Mountain.**CT:** Woodford, Lawson, Wentworth Falls.**Habitat****Habitat:** Wet sand or peaty heathland soils.**Altitude:** 0–1000 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Frequent.**Vegetation:** Low open shrubland e.g. with *Banksia robur*, and beside creeks e.g. with *Lepyrodia scariosa*, *Drosera binata*, *Baeckea litifolia*, *Utricularia dichotoma*.**Substrate:** Damp, but not waterlogged, sandy soil on sandstone. Traps up to 10 cm deep in substrate, low-nutrient soil pH 4.5–5.5 (R. Jobson pers. comm.).**Exposure:** Full sun to semi shade (R. Jobson pers. comm.).**Conservation****Conservation:** Some sites in conservation reserves but overall status unknown. Some sites in Royal NP especially Jibbon Lagoon threatened by disturbance from deer populations digging up extensive patches of heath to get to flowing water beneath the surface (R. Jobson pers. comm.).***Utricularia uliginosa*****LENTIBULARIACEAE**

Asian Bladderwort

Life history**Growth form:** Terrestrial or subaquatic annual or perennial carnivorous herb without roots; stems modified to appear and function as roots, leaves and traps for capturing organisms for food.**Vegetative spread:** Stolons, rhizoids and plants produced on leaves (R. Jobson pers. comm.).**Longevity:** Perennial (R. Jobson pers. comm.).**Primary juvenile period:** More than 1 year (in laboratory) (R. Jobson pers. comm.).**Flowers:** Lilac or violet, rarely all white, throughout the year. Presumably insect-pollinated (Juniper et al. 1989), also self-pollinated (R. Jobson pers. comm.).**Fruit/seed:** Globose capsule, usually with numerous seeds, 0.3 mm diam., seed weight 8.5 µg (R. Jobson pers. comm.).**Dispersal, establishment & growth:** Dispersed by birds and water, seeds rarely germinate, water containing high levels of humic acid seems to trigger germination; seeds germinated after 1 year of culture in laboratory (R. Jobson pers. comm.).**Fire response:** Population density did not seem to change after heath fire in Royal NP (R. Jobson pers. comm.).**Interaction with other organisms:** Mucilage of glands and trichomes on trap surfaces contain bacilli bacteria that attract bacteriophagous crustaceans (Harpacticoids) (R. Jobson pers. comm., laboratory experiments & in situ observations).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC; Qld, N.T., W.A., N.Cal., Malesia, Asia, India.**Distribution Sydney area:** Coast, north from Royal NP.**Select locations:** CC: Morisset, Wondabyne, Centennial Park (1956), La Perouse, Royal NP.**Habitat****Habitat:** Seasonally flooded sandy ground, shallow pools, banks and rocky beds of streams.**Altitude:** 0–100 m**Annual rainfall:** 1200–1600 mm**Typical local abundance:** Frequent.**Vegetation:** Creekbanks and depressions e.g. with *Melaleuca thymifolia*, *Hypolaena fastigata*, *Selaginella uliginosa*.**Substrate:** Damp mud or sand, or water up to 30 cm deep, saturated to flowing. Sometimes in low ledge soaks e.g. 5 m above sea level and 10 m from ocean, low salinity, pH 4.5–6.5.**Exposure:** Full sun to semi shade (R. Jobson pers. comm.).**Conservation****Conservation:** Not known. Some sites in Royal NP especially Jibbon Lagoon disturbed by deer populations digging up extensive patches of heath to get to flowing water beneath the surface (R. Jobson pers. comm.).

Utricularia uniflora

LENTIBULARIACEAE

Life history

Growth form: Terrestrial, probably perennial carnivorous herb with small leaves and without roots; stems modified to appear and function as roots, leaves and traps for capturing organisms for food.

Vegetative spread: Stolons and rhizoids (R. Jobson pers. comm.).

Longevity: Perennial (R. Jobson pers. comm.).

Primary juvenile period:

Flowers: Mauve or lilac, August–May. Presumably insect-pollinated (Juniper et al. 1989).

Fruit/seed: Capsule, usually with numerous seeds. Seeds egg-shaped, 0.4 mm long, seed production opportunistic and seeds rarely develop (R. Jobson pers. comm.).

Dispersal, establishment & growth: Dispersed by water and birds (R. Jobson pers. comm.).

Fire response: Possibly resprouts (R. Jobson pers. comm.).

Interaction with other organisms: Mucilage of glands and trichomes on trap surfaces probably contain bacilli bacteria that attract bacteriophagous crustaceans (Harpacticoids) (R. Jobson pers. comm., laboratory experiments & in situ observations).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CT; Qld, Vic., Tas.

Distribution Sydney area: Coast and Upper Blue Mountains.

Select locations: CC: Ku-ring-gai Chase NP, Rose Bay (1900), Como, Royal NP, West Dapto. CT: Rylstone, Blackheath.

Habitat

Habitat: Bogs or wet soil near streams.

Altitude: 0–1000 m **Annual rainfall:** 1000–1400 mm

Typical local abundance: Frequent–occasional.

Vegetation: Creekbank vegetation e.g. with *Baeckea linifolia*, *Gleichenia*, *Drosera binata*, *Bauera rubioides*, *Xyris* sp.

Substrate: Moist soil on sandstone or sandstone rocks, low nutrients. Able to occupy drier regions than *U. uliginosa* but also saturated soil, pH 4.5–5.5 (R. Jobson pers. comm.).

Exposure: Full sun to semi shade (R. Jobson pers. comm.).

Conservation

Conservation: Occurs in several reserved areas, but tends to occur in places which get trampled by bushwalkers and it is not clear how well it survives, could this be a local threat? (P. Adam pers. comm.). Disturbed by deer at Jibbon Lagoon (R. Jobson pers. comm.).

Linum marginale

LINACEAE

Native Flax, Wild Flax

Life history

Growth form: Erect perennial herb to 10–60 cm high.

Vegetative spread: No.

Longevity:

Primary juvenile period:

Flowers: Blue, September–November.

Fruit/seed: Papery capsule 4–6 mm diam. with brown flat shiny seeds 3 mm long, mature October–November.

Dispersal, establishment & growth: No particular morphology for dispersal (McIntyre et al. 1995).

Fire response: Possibly resprouts at ground level or below.

Interaction with other organisms: Suspected of causing hydrocyanic acid poisoning if eaten by stock (Harden 1992, Hurst 1942). Host of Flax Rust *Melampsora lini* (Burdon & Jarosz 1991, 1992).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT ST NWS CWS SWS NWP SWP NFWP; Qld, Vic., Tas., S.A., W.A.

Distribution Sydney area: Coast and Cumberland Plain.

Select locations: CC: Cheltenham, Como (1887), Kogarah (1893), Newington (Silverwater), Rooty Hill, Prospect, Camden, Dapto (1912).

Habitat

Habitat:

Altitude: 0–100 m **Annual rainfall:** 800–1400 mm

Typical local abundance: Occasional.

Vegetation: Eucalypt open-forest with grassy-shrubby understorey e.g. with *Eucalyptus tereticornis*, *E. moluccana*; Cumberland Plain Woodland, Turpentine-Ironbark forest.

Substrate: Clay soils from Wianamatta Shale, medium nutrients, well-drained.

Exposure: Sheltered, full sun to light shade.

Conservation

Conservation: Rare, mostly old records, much of former range destroyed by urban housing. Vulnerable in Western Sydney (Benson & McDougall 1991).

***Linum trigynum* ***

LINACEAE

French Flax

Life history

Growth form: Herb 10–50 cm high.

Vegetative spread: No.

Longevity: Less than 1 year.

Primary juvenile period: Less than 1 year.

Flowers: Yellow, October–February, peak December.

Fruit/seed: Egg-shaped capsule 2–3 mm long, with brown seeds 2 mm long, October–February.

Dispersal, establishment & growth:

Fire response: Possibly killed after high intensity fire (1/94) at Narrabeen and Lane Cove, with seedlings flowering and fruiting within 11 months after high intensity fire (1/94) at Lane Cove (P. Kubiak pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to Mediterranean and S Europe.

Botanical subregions: NC CC SC CT ST SWS; Vic., W.A.

Distribution Sydney area: Widespread.

Select locations: CC: Denistone, St Ives, Kogarah (1893), Windsor, Leppington, Menangle (1894), Campbelltown, Wollongong. CT: Bowral.

Habitat

Habitat:

Altitude: 0–600 m **Annual rainfall:** 800–1200 mm

Typical local abundance: Frequent.

Vegetation: Grassland and weedy areas, garden weed.

Substrate: Clay soil on Wianamatta Shale.

Exposure:

Conservation

Conservation: Minor weed of gardens and grassland areas, particularly in disturbed areas.

***Linum usitatissimum* ***

LINACEAE

Flax, Linseed

Life history**Growth form:** Herb 30–80 cm high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Blue or white, September.**Fruit/seed:** Round capsule 9 mm long, with brown seeds 4 mm long, September–October.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:** Widely cultivated for commercial flax fibres (from stems), oil-cake for stock-feed (from seeds) and linseed oil (from seeds) (Harden 1992).**Distribution****Status/origin:** Exotic, native to Europe and ?Asia.**Botanical subregions:** NC CC CT ST NWS CWS SWS NWP SWP; Vic.**Distribution Sydney area:** Sporadic.**Select locations:** CC: Kurnell (1965), Sandown, Castlereagh SF, Roberts Creek (Windsor).

CT: Linden (1965).

Habitat**Habitat:** Riverbanks, disturbed sites.**Altitude:** 0–500 m**Annual rainfall:** 800–1200 mm**Typical local abundance:** Rare.**Vegetation:** Dune scrub e.g. with *Acacia sophorae*; open-forest e.g. with *Eucalyptus amplifolia*, *E. fibrosa*.**Substrate:** Sandy soils on sand, sandstone and alluvium.**Exposure:****Conservation****Conservation:** Infrequently naturalised.***Hypsela sessiliflora***

LOBELIACEAE

Life history**Growth form:** Small prostrate herb rooting at nodes.**Vegetative spread:** Roots at nodes of prostrate stems.**Longevity:****Primary juvenile period:****Flowers:** White or pale purple, sessile in leaf axils.**Fruit/seed:** Indehiscent capsule, with long smooth seeds.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** CC.**Distribution Sydney area:** Western Sydney.**Select locations:** CC: South Creek.**Habitat****Habitat:** Damp places.**Altitude:** 0–200 m**Annual rainfall:** 700–900 mm**Typical local abundance:****Vegetation:****Substrate:****Exposure:****Conservation****Conservation:** Local endemic species. Listed as extinct species under schedule 1, NSW Threatened Species Conservation Act 1995 and coded 2X on national rare species list (Briggs & Leigh 1996).

Isotoma axillaris

LOBELIACEAE

Showy Isotome

Life history

Growth form: Erect or ascending perennial herb to 50 cm high; stems often purplish with short hairs.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Bright blue to mauve, rarely pink or white with yellow, white or greenish throat, October–July.

Fruit/seed: Ellipsoid capsule c. 8 mm diameter.

Dispersal, establishment & growth:

Fire response: Probably resprouts from base.

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic.

Distribution Sydney area: Widespread.

Select locations: CC: Yengo NP, Douglas Park, Thirlmere Lakes. CT: Kandos Weir, Cullen Bullen, Gardiners Gap, Wolgan Gap, Jenolan Caves, Kowmung R., Mt Jellore, The Gib, Tallong.

Habitat

Habitat: Rocky crevices, creekbanks, hillsides.

Altitude: 0–1000 m **Annual rainfall:** 900–1100 mm

Typical local abundance: Rare–occasional.

Vegetation: Woodland e.g. with *Eucalyptus rossii*, *E. sieberi*.

Substrate: Sandy loam, often skeletal, on sandstone, low nutrients, well-drained.

Exposure:

Conservation

Conservation: Not known.

Isotoma fluviatilis subsp. *australis*

LOBELIACEAE

Swamp Isotome

Life history

Growth form: Prostrate perennial herb rooting at nodes, often mat-forming. Variable species depending on seasonal conditions; difficult to separate subsp. *australis* from subsp. *borealis* (Harden 1992), subsp. *australis* is tetraploid and hermaphrodite (McComb 1970).

Vegetative spread: Roots at nodes of stems, often forming mats.

Longevity: Indefinite.

Primary juvenile period:

Flowers: Blue, rarely pink, bisexual, November–January.

Fruit/seed: Capsule 3–6 mm diameter with numerous small seeds.

Dispersal, establishment & growth: Diaspore: probably seed.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CT ST CWS SWS; Vic., Tas., S.A.

Distribution Sydney area: Wallerawang to Goulburn.

Select locations: CT: Wallerawang, Mandurama, Oberon, Jenolan Caves, Abercrombie Caves, Tarralga, Paddys River, Marulan.

Habitat

Habitat: Creek banks, wet places.

Altitude: 900–1200 mm **Annual rainfall:** 800–1100 mm

Typical local abundance: Occasional.

Vegetation: Grassy swamp, creek banks, wet field.

Substrate: Moist sand or mud at edge of streams or seepage areas.

Exposure:

Conservation

Conservation: Subsp. *australis* is the most widespread of the subspecies, occurring to the south of the diploid *borealis* in NSW and also in Victoria, S Australia and Tasmania (McComb 1970). Conservation status not known.

Isotoma fluviatilis* subsp. *borealis

LOBELIACEAE

Swamp Isotome

Life history

Growth form: Prostrate perennial herb rooting at nodes, often mat-forming. Variable species depending on seasonal conditions; difficult to separate subsp. *borealis* from subsp. *australis* (Harden 1992), subsp. *borealis* is diploid and hermaphrodite (McComb 1970).

Vegetative spread: Roots at nodes of stems, often forming mats.

Longevity: Indefinite.

Primary juvenile period:

Flowers: White or pale blue; bisexual, though some populations have plants with bisexual flowers and some with only female flowers (Harden 1992). Flowers November–April, peak December.

Fruit/seed: Capsule 3–6 mm diameter, with numerous small seeds.

Dispersal, establishment & growth: Diaspore: probably seed.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC NT CT CWS; Qld.

Distribution Sydney area: Rylstone–Hazelbrook.

Select locations: CT: Olinda, Kandos, Ben Bullen SF, Cullen Bullen, Bathurst, Rydal, Medlow, Hazelbrook.

Habitat

Habitat: Moist sand or mud at edge of streams or seepage areas.

Altitude: 800–1000 m **Annual rainfall:** 800–1200 mm

Typical local abundance: Frequent–occasional.

Vegetation: *Sphagnum* bogs and eucalypt open-forest e.g. with *Leptospermum* understorey or grasses and sedges.

Substrate: Sandy soils on sandstone, low nutrients, impeded drainage.

Exposure:

Conservation

Conservation: Southern geographical limit is Hazelbrook (last collected 1904). Specimens collected near Randwick Racecourse (1891–1900) are probably introductions of subsp. *borealis* (McComb 1970). Conservation status not known.

Isotoma fluviatilis* subsp. *fluviatilis

LOBELIACEAE

Swamp Isotome

Life history

Growth form: Prostrate perennial herb rooting at nodes, often mat-forming.

Subsp. *fluviatilis* is diploid, dioecious (McComb 1970).

Vegetative spread: Roots at nodes of stems, often forming mats.

Longevity: Indefinite.

Primary juvenile period:

Flowers: White or pale blue; unisexual male and female flowers on separate plants, September–April (peak December).

Fruit/seed: Capsule 3–6 mm diam. with numerous small seeds.

Dispersal, establishment & growth: Diaspore: probably seed. Plants probably killed by dry periods and recruit during subsequent wet periods though not known whether from soil-stored seedbank or seed blown/washed in from elsewhere.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC; LHI.

Distribution Sydney area: Mainly north and west of Sydney.

Select locations: CC: Wilberforce, Agnes Banks, Berkshire Park, Yarramundi, Narrabeen Lake, Gordon, Kellyville, Cecil Park, Springwood.

	Habitat
Habitat: Periodically wet sites, margins of swamps, floodplains.	
Altitude: 0–500 m Annual rainfall: 800–1200 mm	
Typical local abundance: Occasional.	
Vegetation: Floodplain forest e.g. with <i>Eucalyptus parramattensis</i> ; woodland e.g. with <i>Melaleuca decora</i> .	
Substrate: Clay soils on Wianamatta Shale, occasionally sandstones, medium nutrients.	
Exposure: Exposed to sheltered.	
	Conservation
Conservation: Now restricted due to destruction of habitats. Conservation status unknown.	

Lobelia alata

LOBELIACEAE

Angled Lobelia

Life history

Growth form: Ascending to creeping herb with branches to 50 cm long.
Vegetative spread: Roots at nodes of stems.
Longevity: Perennial.
Primary juvenile period: 15 months (P. Kubiak pers. comm.).
Flowers: Blue to white, November–May. Flowers visited by native bees (?*Homalictus* sp., Halictidae) probably for nectar, also visited by hoverfly (Syrphidae) (P. Kubiak pers. comm.).
Fruit/seed: Capsule 5–15 mm long.
Dispersal, establishment & growth:
Fire response: Seedlings reported after high intensity fire (1/94) at Narrabeen, with some reaching maturity in less than 15 months (P. Kubiak pers. comm.).
Interaction with other organisms: Vesicular-arbuscular mycorrhiza (Warcup 1988).

Distribution

Status/origin: Native.
Botanical subregions: NC CC SC CT; LHI, Qld, Vic., Tas., S.A., W.A.; N.Z., S Afr, S Amer.
Distribution Sydney area: Mainly coastline, occasionally Blue Mountains.
Select locations: CC: Wamberal, Barrenjoey, Crosslands, Middle Harbour Creek (L.McD.), Willoughby, Bondi, Maroubra, Tempe (1917), Audley, Kiama, Buralow Swamp, Linden. CT: Lawson, Blackheath.

Habitat

Habitat: Brackish marshes, swampy heath, along streams, sea cliffs near waterfalls.
Altitude: 0–1000 m **Annual rainfall:** 1000–1400 mm
Typical local abundance: Frequent–occasional.
Vegetation: Brackish swamps e.g. with *Melaleuca* and saltmarsh; and less commonly fresh swamp e.g. with *Splagnum*, *Leptospermum juniperinum*, *Elcochiaris sphacelata*, *Gleichenia* sp. Warm temperate rainforest, littoral rainforest in seepages, near waterfalls, seepages (A. Bofeldt & M. Robinson pers. comm.).
Substrate: Peaty sand on sandstone, seepage cracks, low nutrients, permanently wet, tolerant of saline conditions. Quaternary alluvium, Narrabeen series, Blow Hole Latite Member in Illawarra (A. Bofeldt & M. Robinson pers. comm.).
Exposure: Full sun to light shade. Salt spray tolerant (A. Bofeldt & M. Robinson pers. comm.).

Conservation

Conservation: Not known.

Lobelia dentata**LOBELIACEAE****Life history**

Growth form: Slender erect herb to 40 cm high; stems often reddish, appears to have fleshy rhizome.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Deep to royal blue, at any time. Peak flowering in first year after fire, declining thereafter with no flowers seen 2–3 years post-fire, flowers visited by native bees, small Skipper butterfly, small grey butterfly (Lycaenidae) and cabbage white butterfly *Pieris rapae rapae* (Pieridae), probably pollinated mainly by native bees (P. Kubiak pers. comm.).

Fruit/seed: Capsule 4–7 mm long, with numerous small seeds.

Dispersal, establishment & growth: Recruitment episodic, mainly fire related.

Fire response: Conspicuous after fire, apparently resprouting from very deeply-buried fleshy rhizome, flowering 6–7 months after prescribed burn West Head Rd (February), flowering 6 months after medium intensity prescribed burn at Forestville (May)(L.McD.). Some plants flowering within 5 months after high intensity fire (1/94) at Lane Cove; plants shedding seeds in less than 1 year (probably seedlings)(P. Kubiak pers. comm.). Plant not evident in long unburnt areas.

Interaction with other organisms: Reported eaten by rabbits (P. Kubiak pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CT ST.

Distribution Sydney area: Mainly coast and Blue Mountains.

Select locations: CC: Calga, Brooklyn, Kenthurst, Bilpin, Springwood, Avalon, Como, Austinmer, Cordeaux Dam. CT: Katoomba, Belmore Falls.

Habitat

Habitat: Ridge tops, sandstone slopes.

Altitude: 0–1000 m **Annual rainfall:** 900–1400 mm

Typical local abundance: Frequent–occasional.

Vegetation: Open-forest e.g. with *Angophora costata*, *Eucalyptus piperita*, *Corymbia gunnifera*, *Corymbia eximia* and shrubs e.g. *Acacia terminalis*, *Persoonia pinifolia*, *Leptospermum* sp.

Substrate: Sandy soil over sandstone, low nutrients, well-drained.

Exposure: Full sun.

Conservation

Conservation: Unknown.

Lobelia gibbosa**LOBELIACEAE**

Tall Lobelia

Life history

Growth form: Erect herb to 65 cm high; stems often reddish.

Vegetative spread: No.

Longevity: Less than 1 year.

Primary juvenile period:

Flowers: Pale blue to deep violet, rarely white, November–May.

Fruit/seed: Capsule 4–7 mm long, with very fine brown seed, 0.2 mm long, 3–5 µg weight (Warcup 1988).

Dispersal, establishment & growth: Diaspore: seed, probably wind-dispersed. Seed requires a ripening period of several months or longer before germination; seedling subterranean and completely dependent on its mycorrhizal (ascomycetes) association for first 3–4 months of its growth, germinating in April–May and visible above ground in September; mycorrhizal companion plants necessary for seedling development and may contribute to growth (Warcup 1988).

Fire response: Possibly resprouts, reported flowering within 12 months of bushfire.

Interaction with other organisms: Both vesicular-arbuscular mycorrhizal and ectomycorrhizal, *Lobelia gibbosa* resembles orchids in that seedling growth does not occur in the absence of an appropriate mycorrhizal fungus or an external source of soluble carbohydrate; the mycorrhizal association may be the reason for difficulty in cultivation of *L. gibbosa* (Warcup 1988).

Distribution	
Status/origin: Native.	
Botanical subregions: NC CC SC NT CT ST SWS NWP; Qld, Vic., Tas., N.T., S.A., W.A.	
Distribution Sydney area: Sporadic.	
Select locations: CC: Wyong (1949). CT: Newnes Plateau, Marrangaroo Creek.	
Habitat	
Habitat: Woodland and forest.	
Altitude: 0–1000 m Annual rainfall: 1000–1200 mm	
Typical local abundance: Rare to occasional.	
Vegetation: Open-forest e.g. with <i>Eucalyptus dives</i> , <i>E. radiata</i> .	
Substrate: Sandy soil on sandstone, low nutrients.	
Exposure:	
Conservation	
Conservation: A variable species requiring further study: segregates are sometimes recognised (Harden 1992). Last collected in CC at Wyong in 1949. Conservation status not known.	

Lobelia gracilis

LOBELIACEAE

Trailing Lobelia

Life history	
Growth form: Erect to decumbent herb usually less than 30 cm high.	
Vegetative spread: No.	
Longevity: Annual (Warcup 1988).	
Primary juvenile period: Less than 1 year.	
Flowers: Blue–purple, November–July, peak March–April. Rarely has white flowers; in summer the petals roll up lengthwise late in afternoon and unfurl in the morning; appears to die off in winter after flowering; flowers visited by native bees ? <i>Amegilla</i> sp. Blue Banded Bees (?Anthophoridae, ?Euryglossinae. ?Colletidae); probably pollinated by 3 species of native bee (P. Kubiak pers. comm.).	
Fruit/seed: Capsule 3.5–4 mm long, with numerous small seeds.	
Dispersal, establishment & growth: Diaspore: seed.	
Fire response: Probably killed. Flowering less than 1 year after high intensity fire (1/94) at Lane Cove, and plants with mature fruit in 17 months after fire (P. Kubiak pers. comm.).	
Interaction with other organisms: Reported heavily cropped by rabbits (P. Kubiak pers. comm.).	

Distribution	
Status/origin: Native.	
Botanical subregions: NC CC NT NWS; Qld.	
Distribution Sydney area: Royal NP to Hawkesbury River.	
Select locations: CC: South Maroota, Crosslands, Pennant Hills, Ryde, Long Bay, Kurnell, Peakhurst, Ingleburn, Audley, Bundeena.	
Habitat	
Habitat: Ridges, slopes.	
Altitude: 0–100 m Annual rainfall: 800–1600 mm	
Typical local abundance: Rare–occasional.	
Vegetation: Open-forest e.g. with <i>Syncarpia glomulifera</i> – <i>Eucalyptus globoidea</i> ; woodland e.g. with <i>Corymbia gummifera</i> , <i>Angophora hispida</i> ; and scrub e.g. with <i>Banksia ericifolia</i> .	
Substrate: Sandy soil on sandstone, occasionally clay soils on shale, low nutrients.	
Exposure:	
Conservation	
Conservation: Royal NP is southern geographical limit, conservation status unknown.	

Lobelia trigonocaulis

LOBELIACEAE

Forest Lobelia

Life history

Growth form: Sparsely hairy creeping or trailing herb with flattened branches 30–50 cm long.

Vegetative spread: Rooting at nodes.

Longevity:

Primary juvenile period:

Flowers: Mauve-blue, December.

Fruit/seed: Capsule 3.5–5 mm long, with seeds 1 mm long.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC NT; Qld.

Distribution Sydney area: Sporadic.

Select locations: CC: Ourimbah, Wrights Creek (Wisemans Ferry).

Habitat

Habitat: Creekbanks.

Altitude: 0–200 m

Annual rainfall: 900–1200 mm

Typical local abundance: Rare.

Vegetation: Rainforest margins e.g. with *Adiantum formosum*, *Hibiscus heterophyllous*, *Aemena smithii*, *Glochidion ferdinandi*; or scrub e.g. with *Leptospermum polygalifolium*.

Substrate: Sandy soil on alluvium, low to medium nutrients.

Exposure: Light to mid shade.

Conservation

Conservation: Ourimbah is southern geographical limit (Harden 1992).

***Monopsis simplex* var. *simplex* ***

LOBELIACEAE

Life history

Growth form: Procumbent to ascending perennial herb with branches to 30 cm long, sometimes rooting from lower nodes.

Vegetative spread: From horizontal stems rooting at lower nodes.

Longevity:

Primary juvenile period:

Flowers: Deep purple, hairy on the outside, October–December.

Fruit/seed: Capsule 4.5 mm long.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to S Africa.

Botanical subregions: CC; Vic., S.A., W.A.

Distribution Sydney area: Eastern suburbs–Cooks River.

Select locations: CC: South Head, Randwick, La Perouse, Alexandria Swamps (1888), Cooks River (1909).

Habitat

Habitat: Swamps, damp sites.

Altitude: 0–100 m

Annual rainfall: 1000–1200 mm

Typical local abundance: Occasional.

Vegetation: Probably sedgeland.

Substrate: Damp sandy soil on sand or sandstone.

Exposure:

Conservation

Conservation: Naturalised in eastern suburbs–Cooks River in late 19th century but has not spread further and is now rare.

Pratia concolor

LOBELIACEAE

Life history

Growth form: Low growing, hairless, perennial herb; branches often zigzagging.**Vegetative spread:** Spreads by rhizomatous roots up to 1 m.**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** White or pink tinged with purple, male and female flowers on separate plants, June–December.**Fruit/seed:** Globular, somewhat fleshy 4–8 mm diam., not splitting when ripe, with numerous small seeds.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:** Suspected of poisoning stock; Murrami disease in horses, where horses suddenly collapse or die when subjected to mild exercise or work or to sudden fright, has been attributed to alkaloids contained in this plant (Cunningham et al. 1981).

Distribution

Status/origin: Native.**Botanical subregions:** NC CC NWS CWS SWS NWP SWP; Qld, Vic.**Distribution Sydney area:** Cumberland Plain (rare), Wondabyne.**Select locations:** CC: Wondabyne, Doonside, Glenfield, Kemps Creek.

Habitat

Habitat: Near creeks.**Altitude:** 0–200 m**Annual rainfall:** 700–1200 mm**Typical local abundance:** Rare.**Vegetation:** Ground stratum in eucalypt woodland.**Substrate:** Near drainage lines, on clay soils over shale, medium nutrients. Watertable mostly high, moisture supply intermittent, fresh.**Exposure:**

Conservation

Conservation: Vulnerable in Western Sydney (Benson & McDougall 1991).*Pratia pedunculata*

LOBELIACEAE

Matted or Trailing *Pratia*

Life history

Growth form: Perennial herb with ascending or prostrate branches often mat-forming.

There is some doubt as to the correct use of this name (Harden 1992).

Vegetative spread: Rhizomatous and rooting from nodes of prostrate branches.**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** White or bluish mauve, male and female flowers on different plants, November–January.**Fruit/seed:** Fleshy fruit 4–10 mm long, with numerous small seeds.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:** Vesicular-arbuscular mycorrhiza (Warcup 1988).

Distribution

Status/origin: Native.**Botanical subregions:** CT NT ST; Vic., Tas., S.A.**Distribution Sydney area:** Lithgow.**Select locations:** CT: Littleton (Lithgow 1893).

Habitat

Habitat: Damp sites at higher altitudes.**Altitude:** 1000 m**Annual rainfall:** 900 mm**Typical local abundance:****Vegetation:** Woodland and grassland.**Substrate:** Probably sandy soil on sandstone.**Exposure:**

Conservation

Conservation: Rare, only record for Sydney area is Brown Mountain near Littleton 1893. Conservation status unknown, possibly locally extinct.

Pratia purpurascens

LOBELIACEAE

Whiteroot

Life history

Growth form: Glabrous herb, with long white rhizomes, undersurface of leaves purplish; contains the alkaloid lobeline.

Vegetative spread: Spreading up to 1 m by rhizome.

Longevity: Indefinite.

Primary juvenile period:

Flowers: White–pale purplish, pink, bluish–lilac, sweet-scented, male and female flowers on separate plants, November–June, peak April. Flowers visited by native bee, honey bees, brown flies, and small butterflies (5 species) for nectar, and probably also playing a role in pollination (P. Kubiak pers. comm.).

Fruit/seed: Capsule, 3–10 mm long, with numerous seeds.

Dispersal, establishment & growth: Diaspore: seed, no special dispersal morphology (Westoby et al. 1990).

Fire response: Resprouts after high-intensity fire, may flower within 4 months. Some resprouting plants flowered 9 weeks after high intensity fire (1/94) at Lane Cove, scattered plants had green fruit within 4 months (P. Kubiak pers. comm.).

Interaction with other organisms: Vesicular-arbuscular mycorrhiza (Warcup 1988).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT NWS; LHI, Qld, Vic.

Distribution Sydney area: Widespread.

Select locations: CC: Wyong, Beecroft, Strathfield, Botany (1923), Pitt Town, Glenbrook, Menangle, Yerrinbool, Austinmer, Berry, Macquarie Pass. CT: Kowmung River, Oberon.

Habitat

Habitat: Shaded wet areas in forest, levee banks.

Altitude: 0–1000 m

Annual rainfall: above 800 mm

Typical local abundance: Frequent.

Vegetation: Open-forest e.g. with *Eucalyptus saligna*, *Angophora floribunda*; woodland e.g. with *Eucalyptus fibrosa*, *E. sclerophylla*, *E. eugenioides*, *E. tereticornis*, *E. bosistoana*, *Melaleuca decora*, *M. styphelioides*; shrubland with *Melaleuca armillaris*, *M. uodosa*; and swamp with *Eleocharis sphacelata*, *Juncus usitatus*.

Substrate: Various moist soils from basalt, volcanic necks, shales, sandstone, sandy clays and alluvial sediments, medium–low nutrients. Berry Siltstone, Budgong Sandstone in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Mid–light shade.

Conservation

Conservation: Widespread species, probably adequately conserved.

Pratia surrepens

LOBELIACEAE

Mud Pratia

Life history

Growth form: Prostrate creeping perennial herb with stems to 16 cm long, rooting at nodes.

Vegetative spread: By rooting at nodes of prostrate stems.

Longevity: Indefinite.

Primary juvenile period:

Flowers: White or tinged with pale violet or pale blue, November–February.

Fruit/seed: Fleshy fruit 4–5 mm long, with numerous small seeds.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CT ST; Vic., Tas.

Distribution Sydney area: Lidsdale–Ben Bullen, Southern Highlands.

Select locations: CT: Lidsdale, Boyd Plateau swamps (Kodala et al. 1996), Ben Bullen SF, Mittagong, Wingecarribee Swamp, Long Swamp (Kodala et al. 1992), Exeter, Fitzroy Falls.

Habitat: Swampland margins, depressions.		Habitat
Altitude: 600–1000 m	Annual rainfall: 900–1600 mm	
Typical local abundance: Frequent–occasional.		
Vegetation: Wet heath e.g. with <i>Leptospermum</i> , <i>Hakea microcarpa</i> ; and montane peatland e.g. with <i>Sphagnum</i> hummocks and <i>Viola caleyana</i> , <i>Centella cordifolia</i> , <i>Drosera peltata</i> , <i>Hydrocotyle peduncularis</i> .		
Substrate: Moist peaty or clay soils, often over sandstone, impeded drainage, permanent moisture, low to medium nutrients.		
Exposure:		
Conservation: Not known.		Conservation

Gelsemium sempervirens *

LOGANIACEAE

Growth form: Glabrous, twining climber with opposite leaves.		Life history
Vegetative spread:		
Longevity:		
Primary juvenile period:		
Flowers: Golden-yellow, mainly September–February.		
Fruit/seed: Capsule 15–25 mm long; seeds 12–15 mm long including wing to 10 mm long.		
Dispersal, establishment & growth: Diaspore: winged seed.		
Fire response:		
Interaction with other organisms:		
Status/origin: Exotic, native to N America and Mexico.		Distribution
Botanical subregions: CC.		
Distribution Sydney area: Hornsby.		
Select locations: CC: Hornsby (1914), Albion Park (1997) (M. Robinson p.c.).		
Habitat:		Habitat
Altitude: 0–200 m	Annual rainfall: 1200–1300 mm	
Typical local abundance:		
Vegetation: Woodlands with <i>Eucalyptus tereticornis</i> , <i>E. eugenioides</i> , <i>Melaleuca decora</i> (M. Robinson pers. comm.).		
Substrate: Clay soils on volcanic neck, Berry Siltstone in Illawarra (M. Robinson pers. comm.), medium nutrients.		
Exposure: Full sun (M. Robinson pers. comm.).		
Conservation: Reported once as a garden escape in Sydney region. Rare.		Conservation

Logania albiflora**LOGANIACEAE****Life history**

Growth form: Erect shrub to 2 m high, this species is extremely variable in terms of leaf size. Includes *Logania floribunda* variant of Conn (1995).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: White, male and female flowers on separate plants, May–November, peak September.

Fruit/seed: Capsule 5–9 mm long, seeds 2 mm long, mainly September–January.

Dispersal, establishment & growth:

Fire response: Resprouted from base after high-intensity fire (1/94) at Katandra (L.McD.). Secondary juvenile period less than 1 year (at Deepwater Creek), more than 3 years (at Katandra, L.McD.). Resprouting plants mostly flowering and fruiting in 3 years after high intensity fire (1/94) at Lane Cove (P. Kubiak pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWP; LHI, Qld, Vic.

Distribution Sydney area: Widespread.

Select locations: CC: Putty, Colo Heights, Bowens Creek, Beecroft, Silverwater, Kentlyn, Garie, Albion Park, Rylstone, Springwood. CT: Mt Wilson, Carrington Falls.

Habitat

Habitat: Hillsides and gullies.

Altitude: 0–1000 m **Annual rainfall:** 800–1400 mm

Typical local abundance: Frequent–occasional.

Vegetation: Moist to dry open-forest e.g. with *Eucalyptus piperita*, *E. sieberi*, *Angophora costata*, *Corymbia eximia*, *Eucalyptus pilularis*, *E. punctata*, *E. sparsifolia*, *E. oreades*, *Angophora bakeri*, *Syncarpia glomulifera*, *Eucalyptus smithii*, *E. quadrangulata*.

Substrate: Sandy to clay soils on sandstone.

Exposure:

Conservation

Conservation: Widespread and probably adequately conserved.

Logania pusilla**LOGANIACEAE****Life history**

Growth form: Herb or sprawling undershrub to 15 cm high, branches ridged.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: White, male and female flowers on separate plants, September–November, peak October.

Fruit/seed: Capsule 5–9 mm long.

Dispersal, establishment & growth: No special morphology for dispersal (Westoby et al. 1990).

Fire response: Possibly resprouts.

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT ST; Qld, Vic.

Distribution Sydney area: Coast and Lower Blue Mountains.

Select locations: CC: Wisemans Ferry, Hornsby, Terrey Hills, Castle Hill, Tempe (1898), Casula, Cabramatta, Wilton, Bowen Mountain, Linden.

Habitat

Habitat: Ridges.
Altitude: 0–500 m **Annual rainfall:** 800–1200 mm
Typical local abundance: Rare–occasional.
Vegetation: Eucalypt open-forest and woodland e.g. with *Corymbia gummifera*, *Angophora costata*, *Syncarpia glomulifera*, *Banksia serrata*.
Substrate: Clay loam to sandy loam on sandstone, low nutrients, well-drained.
Exposure:

Conservation

Conservation: Uncommon, mostly old records, conservation status unknown.

Mitrasacme alsinoides

LOGANIACEAE

Life history

Growth form: Annual herb to 20 cm high.
Vegetative spread: No.
Longevity: Short-lived, less than 1 year, dies rapidly at onset of summer heat (P. Lister pers. comm.).
Primary juvenile period: 3 months.
Flowers: White, November–March.
Fruit/seed: Capsule 2 mm diam. with many seeds.
Dispersal, establishment & growth: Diaspore: seed, gravity dispersal local, dormant for at least 2 years? Probably recruited from soil-stored seedbank, reported to grow quickly after rain.
Fire response: Probably killed.
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: NC CC; Qld.
Distribution Sydney area: Hawkesbury–Nepean River.
Select locations: CC: Richmond (1910, 1991, 1993), Elderslie (1970).

Habitat

Habitat: High level, riverine alluvial deposits.
Altitude: 0–50 m **Annual rainfall:** 700–800 mm
Typical local abundance: Frequent, 10 plants/100 sq cm.
Vegetation: Ground stratum in moist sedgeland (Elderslie); or low woodland of *Eucalyptus parraimattensis* with lichen ground cover and shrubs e.g. with *Melaleuca nodosa*, *Hakea sericea* (Richmond).
Substrate: Deep moist sandy soil, probably old alluvial deposit, low nutrients. Watertable mostly high (at Elderslie), but low (at Richmond), moisture supply intermittent, fresh.
Exposure: Light shade 10–20% projective foliage cover (Peter Lister pers. comm.), in opening in shrub cover.

Conservation

Conservation: Rare, regarded as extinct in Western Sydney (Benson & McDougall 1991), but recorded at Richmond again in 1991. Early record at Richmond in 1910 suggests that the species occupies a restricted habitat though it is not always apparent there. Inadequately conserved, southern geographical limit at Elderslie but probably extinct there.

Mitrasacme paludosa

LOGANIACEAE

Life history

Growth form: Prostrate, procumbent or erect herb, 5–10 cm high, with weak branches; leaves 4–10 mm long.

Vegetative spread:

Longevity: 5–20 years (D. Keith pers. comm.).

Primary juvenile period: Primary juvenile period 2–5 years (D. Keith pers. comm.).

Flowers: White, January–June.

Fruit/seed: Capsule 1.4–2 mm diam.

Dispersal, establishment & growth: Diaspore: seed.

Fire response: Killed by fire, followed by recruitment from seed (D. Keith pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC NT NWS NWP FWP; Qld.

Distribution Sydney area: Coastal.

Select locations: CC: Richmond, Narrabeen, Manly (1889), Centennial Park (1897), Botany (1880), Cronulla, Marley Lagoon.

Habitat

Habitat: Lagoon margins.

Altitude: 0–50 m

Annual rainfall: 700–1400 mm

Typical local abundance: Rare.

Vegetation: Wet areas e.g. with *Melaleuca* sp., *Utricularia* sp.; or saltmarsh margins e.g. with *Casuarina glauca*, *Livistona australis* (at Cronulla).

Substrate: Wet soils on lagoon margins on deep sandy soils.

Exposure:

Conservation

Conservation: Rare, Marley Lagoon is southern geographical limit. Inadequately conserved.

Mitrasacme pilosa var. *pilosa*

LOGANIACEAE

Life history

Growth form: Prostrate herb 5–10 cm high, mat-forming.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: White, December–August, peak January.

Fruit/seed: Capsule 2–3 mm diam., with numerous minute seeds.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC SC CT ST; Vic., S.A., Tas.

Distribution Sydney area: Mainly Upper Blue Mountains, Southern Highlands.

Select locations: CC: Bulli Pass, Loddon Falls. CT: Clarence, Mt Wilson, Wentworth Falls, Robertson, Belmore Falls, Carrington Falls.

Habitat

Habitat: Wet areas in rocky crevices, near waterfalls.

Altitude: 300–1200 m

Annual rainfall: 1200–1600 mm

Typical local abundance: Occasional.

Vegetation: Low heath e.g. with *Allocasuarina nana*, *Petrophile pulchella*, *Hakea dactyloides*; and shrub swamp e.g. with *Epacris paludosa*, *Gleichenia dicarpa*, *Baeckea linifolia*, *Lepidosperma laterale*, *Empodisma minus*.

Substrate: Sandy to gravelly soil on sandstone, also peaty soils, low nutrients, impeded drainage.

Exposure: Mid shade.

Conservation

Conservation:

Mitrasacme polymorpha

LOGANIACEAE

Life history

Growth form: Erect perennial herb to 25 cm high.
Vegetative spread: No.
Longevity: 5–20 years (D. Keith pers. comm.).
Primary juvenile period: 2–3 years (Benson 1985). Sometimes flowering in first year (Harden 1992).
Flowers: White, August–June, peak September. Probably pollinated by native bees and flies (P. Kubiak pers. comm.).
Fruit/seed: Capsule 2–3 mm diam., with numerous minute seeds. September–May, peak November.
Dispersal, establishment & growth: Diaspore: seed. No special morphology for dispersal (Westoby et al. 1990). Soil-stored seedbank (Fox 1988). Episodic recruitment mainly after fire.
Fire response: Killed by fire (Benson 1985, Fox 1988). Numerous seedlings flowering within 11 months after high intensity fire (1/94) at Lane Cove, with peak flowering within 3 years; some fruits within 11 months (P. Kubiak pers. comm.).
Interaction with other organisms: Flowers visited by native bees for nectar and pollen; hoverflies (Syrphidae) and flies (2 species, Diptera) also reported feeding (P. Kubiak pers. comm.).

Distribution

Status/origin: Native.
Botanical subregions: NC CC SC CT ST; Qld, Vic., Tas.
Distribution Sydney area: Widespread, coastal plateaus and Blue Mountains.
Select locations: CC: Wisemans Ferry, Somersby, Asquith, La Perouse, Wattamolla, Austinmer, Kurrajong Heights. CT: Mt Coricudgy, Newnes Plateau, Blackheath, Mt Werong, Tallong.

Habitat

Habitat: Eucalypt open-forest, woodland, heath on sandstone soils.
Altitude: 0–1200 m **Annual rainfall:** 1000–1400 mm
Typical local abundance: Frequent–occasional.
Vegetation: Woodland e.g. with *Corymbia gummifera*, *Banksia serrata*, *Eucalyptus pauciflora*; open-forest e.g. with *Eucalyptus piperita*, *Angophora costata*, *Eucalyptus paniculata*; and heath e.g. with *Angophora hispida*, *Banksia ericifolia*, *Allocasuarina nana*, *Banksia marginata*, *Dampiera stricta*.
Substrate: Shallow to deep sandy soil on sandstone, quartzite, low nutrient soil, well-drained.
Exposure: Full sun to light shade.

Conservation

Conservation: Widespread and adequately conserved.

Mitrasacme serpyllifolia

LOGANIACEAE

Life history

Growth form: Perennial, more or less prostrate herb 5–10 cm high, often mat-forming.

Vegetative spread: Roots at stem nodes.

Longevity:

Primary juvenile period:

Flowers: Cream, November–February.

Fruit/seed: Capsule 1.2 mm diam., with numerous minute seeds.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NT CT ST; Vic., Tas.

Distribution Sydney area: Upper Blue Mountains, Southern Highlands.

Select locations: CT: Eskbank, Blackheath, Leura, Lawson, Boyd Hill Swamp, Bindook Swamp, Wingecarribee Swamp, Fitzroy Falls, Penrose.

Habitat

Habitat: Swampy, moist rocky areas, near waterfalls and creeks, montane peatland.

Altitude: 600–1000 m

Annual rainfall: 1200–1600 mm

Typical local abundance: Frequent–rare.

Vegetation: Swamp margins e.g. with *Empodisma minus*, *Xyris ustulata*, *Leptospermum obovatum*, *Lepyrodon anarthria*, *Eucalyptus pauciflora*.

Substrate: On damp sandstone rocks and montane peatland, low nutrients.

Exposure:

Conservation

Conservation:

Amyema cambagei

LORANTHACEAE

Life history

Growth form: Pendulous parasitic ashy-grey shrub to more than 1 m long, with ball-like attachment to host plant (Blakely 1923). Partly dependent on host plant for nutrient derived through haustoria or sucking roots and with green leaves also capable of photosynthesis (Blakely 1922).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Pink, May–November. Probably self-pollinated and possibly insect-pollinated (Blakely 1922).

Fruit/seed: Pink or red globular fruit 5–6 mm diam; single seed covered with a gluey substance and enclosed in thin sac (Blakely 1922). Mature December–January.

Dispersal, establishment & growth: Diaspore: fleshy fruit, bird-dispersed (Blakely 1923).

Fire response:

Interaction with other organisms: Parasitic on stems of *Casuarina glauca*, *C. cunninghamiana*, *Allocasuarina littoralis*, *Amyema pendulus*, *A. miquelii*, *Notothixos subaureus*, *Melaleuca linariifolia*, Plum (Blakely 1923).

Limited spring nesting of Mistletoe-bird *Dicaeum hirundinaceum* associated with fruiting of *Amyema cambagei* on *Casuarina cunninghamii* along Nepean River (Keast 1958). Foodplant of Silvereye *Zosterops lateralis*, fruit eaten by Little Lorikeet *Glossopsitta pusilla* (Barker & Vestjens 1989), Eastern Rosella *Platycercus eximius*, Galah *Eolophys roseicapillus* (Blakely 1923). Foodplant of moth larvae *Comocrus behri* (Common 1990).

Distribution**Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP NFWP; Qld.**Distribution Sydney area:****Select locations:** CC: Mangrove Creek, Wisemans Ferry, Grose Vale, Agnes Banks, Penrith, Cobbitty CT: Kowmung River, Wombeyan Caves.**Habitat****Habitat:** Parasitic on stems.**Altitude:** 0–600 m**Annual rainfall:** 600–1200 mm**Typical local abundance:** Occasional.**Vegetation:** Most frequently on *Casuarina cunninghamiana*.**Substrate:** Sandy alluvium.**Exposure:****Conservation****Conservation:** Not known.***Amyema congener* subsp. *congener*****LORANTHACEAE**

Mistletoe

Life history**Growth form:** Erect or spreading parasitic shrub with a ball-like single attachment to host plant, possibly not completely reliant on host for nutrient (Blakely 1922).**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Green or yellow, reddish at base, at any time. Probably self-pollinated and possibly insect-pollinated (Blakely 1922).**Fruit/seed:** Roundish fruit 8 mm long; single seed covered with a gluey substance and enclosed in thin sac (Blakely 1922), mainly December–February.**Dispersal, establishment & growth:** Diaspore: fleshy fruit, bird-dispersed. Commonly develops double radicle at germination; possibly needs moisture to facilitate germination (Blakely 1922).**Fire response:** Killed with host after high intensity fire (1/94) at Lane Cove (P. Kubiak pers. comm.).**Interaction with other organisms:** Main host is *Allocasuarina littoralis* also *A. torulosa*, *Acacia floribunda*, *Melaleuca decora*, *M. styphelioides*, *M. nodosa*, *M. linariifolia*, *Croton verreuxii*, *Cassine australis*, *Eucalyptus obtusifolia*, *Angophora costata* and exotic species e.g. Peach, Pear, Plum, *Nerium oleander**. Only rarely found on *Eucalyptus* species; fruit eaten by Mistletoe-bird *Dicaeum hirundinaceum* (Blakely 1922). Plant damaged by scale insects *Ceroplastes cerciferus*, *C. rubens*, *Aspidiotus aurantii* (Blakely 1922).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC; Qld.**Distribution Sydney area:** Coastal (Blakely 1922).**Select locations:** CC: Mt White, Cowan, Gordon, Meadowbank, Vacluse, Como, Sutherland, Mt Kembla, Albion Park.**Habitat****Habitat:** Near tidal waters of creeks and rivers (Blakely 1922)**Altitude:** 0–200 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Main host is *Allocasuarina littoralis*.**Vegetation:****Substrate:****Exposure:****Conservation****Conservation:**

Amyema gaudichaudii**LORANTHACEAE****Life history**

Growth form: Compact parasitic shrub to more than 1 m diam., with a ball-like single attachment to host plant, possibly less reliant on host for nutrient (Blakely 1922).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Red, September–December. Probably self-pollinated and possibly insect-pollinated (Blakely 1922).

Fruit/seed: Red, globular fruit 4 mm diam., with single seed covered with a gluey substance and enclosed in thin sac (Blakely 1922).

Dispersal, establishment & growth: Diaspore: fleshy fruit, bird-dispersed. Sticky seeds pass through the intestine of Mistletoe-bird *Dicaeum hirundinaceum* within 1 hour and are deposited in 'strings' on the bark of the host where sprouting occurs in a few days with root attachment within a few weeks (Keast 1958). Haustorium interlocks with proliferating cambium of host *Melaleuca decora* (Thoday 1961).

Fire response:

Interaction with other organisms: Main host species *Melaleuca decora*, also recorded on *Melaleuca linariifolia*, *M. nodosa*, *Callistemon linearis*; *Melaleuca styphelioides*. Late summer breeding of Mistletoe Bird *Dicaeum hirundinaceum* associated with fruiting of *Amyema gaudichaudii* on paperbarks in Blacktown/St Marys area (Keast 1958). Fruit eaten by Little Lorikeet *Glossopsitta pusilla* (Barker & Vestjens 1989). Plant damaged by scale insects *Ceroplastes cerciferus*, *C. rubens*, *Aspidiotus aurantii* (Blakely 1922).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC; Qld.

Distribution Sydney area: Mainly western Sydney.

Select locations: CC: Richmond, Mt Druitt, Parramatta, Bankstown, Hurstville, Ingleburn, Liverpool, Glenfield, Razorback, Thirlmere, Yallah.

Habitat

Habitat: Woodland, open-forest.

Altitude: 0–200 m **Annual rainfall:** 900–1000 mm

Typical local abundance: Frequent to occasional.

Vegetation: Parasitic on *Melaleuca decora* etc. in eucalypt woodland e.g. with *Eucalyptus tereticornis*, *E. eugenioides*, *E. longifolia*.

Substrate: Clay soils on Wianamatta Shale, Berry Siltstone, Quarternary alluvium.

Exposure:

Conservation

Conservation: Conservation status unknown. Vulnerable in Western Sydney (Benson & McDougall 1991), threatened in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Amyema miquelii**LORANTHACEAE****Life history**

Growth form: Pendulous, parasitic shrub to 2 m long, light yellowish green, develops a ball-like single attachment to host plant, possibly less reliant on host for nutrient (Blakely 1922).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Usually red, December–January. Probably self-pollinated and possibly insect-pollinated (Blakely 1922).

Fruit/seed: Yellowish red fruit 8–12 mm long; single seed covered with a gluey substance and enclosed in thin sac (Blakely 1922), mature October–January.

Dispersal, establishment & growth: Diaspore: fleshy fruit, bird-dispersed mainly by Mistletoe-bird *Dicaeum hirundinaceum*, with seeds transported for only about 45 km, as seeds are voided in less than 1 hour after ingestion; seeds eaten by Grey-breasted Silveryeye *Zosterops lateralis* sprout in a few days and root attachment occurs in a few weeks (Keast 1958). Germination occurs only if fruit coat is removed (May 1941), the embryo is green while still enclosed in the fruit and can begin to grow in darkness but light is needed for growth and attachment to host (Rigby 1959), germination twice as great in light compared to dark (Gill & Hawkesworth 1961). Development of double radicle at germination, seed possibly 2-celled (Blakely 1922). Population density higher where host trees are taller and have larger canopies (Downey et al. 1997).

Fire response: Killed by high intensity fire (Reid 1997).

Interaction with other organisms: Parasitic on many species of *Eucalyptus* and several *Acacia* species, rarely on other hosts (Harden 1992). Host species include *Eucalyptus tereticornis*, *E. fibrosa*, *E. hemiphloia*, *E. baueriana*, *E. maculosa*, *E. ciurea*, *E. melliodora*; also *Eucalyptus blakelyi*, *E. mannifera*, *E. Macrorrhyncha*, *E. bridgesiana*, *Acacia dealbata* (Downey et al. 1997).

Fruits often distorted by insects; fruit fly *Ceratitis loranthi* hatched from fruit (Blakely 1922), fly larvae *Paratririthrum loranthi* in fruit destroyed seed (May 1941). Fruit eaten by Crimson Rosella *Platycercus elegans* (Lepschi 1993). Late summer breeding of Mistletoe-bird *Dicaeum hirundinaceum* associated with fruiting of *Amyema miquelii* on *Eucalyptus moluccana* in Blacktown/St Marys area (Keast 1958). Foodplant of Brushtail Possum *Trichosurus vulpecula* (Reid 1997). Foodplant of moth larvae *Comocrus behri* (Common 1990).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWS NWP SWP SFWP; Qld, Vic., N.T., S.A., W.A.

Distribution Sydney area: Western Sydney, Bathurst area.

Select locations: CC: St Marys, Liverpool. CT: Capertee, Hill End, Limekilns, Trunkey, Wombeyan Caves.

Habitat

Habitat: Woodland.

Altitude: 0–800 m **Annual rainfall:** 700–1200 mm

Typical local abundance: Occasional–frequent.

Vegetation: Parasitic on species of *Eucalyptus*.

Substrate: Clay soils on shales.

Exposure:

Conservation

Conservation: Vulnerable in Western Sydney (Benson & McDougall 1991).

Amyema pendulum subsp. *pendulum*

LORANTHACEAE

Life history

Growth form: Pendulous, russet-brown parasitic shrub to 1.5 m long, with a ball-like single attachment on the outside of the bark of the host plant, possibly less reliant on host for nutrient (Blakely 1922).

Vegetative spread: No.

Longevity:

Primary juvenile period:

Flowers: Rusty-hairy, March–November. Possibly bird-pollinated, probably self-pollinated and possibly insect-pollinated (Blakely 1922).

Fruit/seed: Brown, urn-shaped fleshy fruit 10 mm long; single seed covered with a gluey substance and enclosed in thin sac (Blakely 1922), March–December.

Dispersal, establishment & growth: Diaspore: fleshy fruit, bird-dispersed. Haustoria attach to proliferating cambium of host plants (Thoday 1961).

Fire response: Killed by high intensity fire (Reid 1997).

Interaction with other organisms: Parasitic on many species of *Eucalyptus* and common on *Acacia* species. Host plants include: Loranthaceae: *Muellerina eucalyptoides*, *A. cambagei*, *Amyema gaudichaudii*, *Dendrophthoe vitellina*; Fabaceae: *Acacia decurrens*, *A. dealbata*, *A. linifolia*, *A. melanoxylon*, *A. penninervis*, *Robinia pseudo-acacia**, *Cytisus proliferus**; Myrtaceae: *Melaleuca decora*, *Eucalyptus baueriana*, *E. blaxlandii*, *E. cinerea*, *E. dives*, *E. sparsifolia*, *E. dalrympleana*, *E. dealbata*, *E. eugenioides*, *E. haemastoma*, *E. moluccana*, *E. pilularis*, *E. piperita*, *E. propinqua*, *E. polyanthemus*, *E. radiata*, *E. rubida*, *E. sieberiana*, *E. stricta*, *E. viminalis*; Asteraceae: *Cassinia aculeata*.

Fruit eaten by Crimson Rosella *Platycercus elegans* (Lepschi 1993). Foodplant of Brushtail Possum *Trichosurus vulpecula* and Ringtail Possum *Pseudocheirus peregrinus*, also Koala (when *Eucalyptus* is the host species) (Reid 1997). Host plant of Cerambycid beetle *Coptopterus cretifer* (Hawkeswood 1993). Foodplant of blue butterfly *Ogyris olane*, which pupates under loose bark at base of host; seed within fruit destroyed by larvae of fly *Ceratitis loranthi*; plant damaged by scale insects *Ceroplastes cerciferus*, *C. rubens*, *Aspidiotus aurantii* (Blakely 1922).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWS; Vic., S.A.

Distribution Sydney area: Widespread.

Select locations: CC: Hornsby, Kurrajong, Glenfield, Camden, Waterfall, Linden, Thirlmere.

CT: Mt Coricudgy, Newnes, Hill End, Blayney, Lake Canobolas, Mittagong, Wingello.

Habitat

Habitat: Woodland. Tall forest, gentle slopes (M. Robinson pers. comm.).

Altitude: 0–1200 m **Annual rainfall:** 700–1400 mm

Typical local abundance: Occasional.

Vegetation: Eucalypt woodland.

Substrate: Soils on shales, sandstone, low–medium nutrients.

Exposure:

Conservation

Conservation: Not known.

Amylothea dictyophleba

LORANTHACEAE

Life history

Growth form: Spreading or hanging aerial stem-parasitic shrub to 1 m diam., with external runners, older stems with corky bark. Attachment and contact with the host plant by haustoria (Blakely 1922).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Usually red, grading into green and yellow. Probably self-pollinated and possibly insect-pollinated (Blakely 1922).

Fruit/seed: Red or purple globose fruit 5–10 mm diam; single seed covered with a gluey substance and enclosed in thin sac (Blakely 1922).

Dispersal, establishment & growth: Diaspore: fleshy fruit, probably bird-dispersed.

Fire response:

Interaction with other organisms: Host plants *Ficus* sp., *Tasmannia insipida*, *Eupomatia laurina*, *Doryphora sassafras*, *Ceratopetalum apetalum*, *Cryptocarya microneura*, *Cupaniopsis anacardioides*, *Acmena smithii* (Blakely 1925), and *Elaeocarpus reticulatus*, *Diospyros australis*.

Distribution

Status/origin: Native.

Botanical subregions: NC CC; Qld, N.G., N.Cal.

Distribution Sydney area: Wyong, Illawarra.

Select locations: CC: Wyong, Carlton (1893), Bulli Pass, Fig Tree, Kangaroo Valley, Cambewarra.

Habitat

Habitat:

Altitude: 0–300 m

Annual rainfall: 1200–1600 mm

Typical local abundance:

Vegetation: Parasitic on many species of rainforest trees.

Substrate:

Exposure:

Conservation

Conservation: Cambewarra is southern geographical limit. Conservation status unknown.

Atkinsonia ligustrina**LORANTHACEAE****Life history**

Growth form: Erect shrub 1–2 m high, parasitic on the roots of nearby plants. Develops 5–6 fleshy primary roots which turn blue when damaged. The main roots up to 2 cm diam. are very soft and pliable growing to almost 2 metres long (Blakely 1922); lateral roots bearing haustoria are freely produced but short-lived (Menzies & McKee 1959). Each haustorium contains a 'gland' that secretes enzymes which facilitate penetration of host plant; haustoria connect with xylem of host plants (Menzies & McKee 1959).

Vegetative spread:

Longevity:

Primary juvenile period: 3–5 years (Maryott-Brown & Wilks 1993).

Flowers: Yellow, sweetly scented, October–May, peak November. Flowering often irregular (Maryott-Brown & Wilks 1993).

Fruit/seed: Scarlet, oblong fleshy fruit 12 mm long; single seed covered with a gluey substance and enclosed in thin sac (Blakely 1922).

Dispersal, establishment & growth:

Fire response: Resprouts (Blakely 1922, Menzies & McKee 1959).

Interaction with other organisms: Single plant parasitic on roots of many plants including *Caustis* sp., *Dillwynia* sp., *Acacia obtusifolia*, *Platysace linearifolia*, *Leptospermum trinervium*, *Monotoca scoparia* (Menzies & McKee 1959).

Distribution

Status/origin: Native.

Botanical subregions: CC CT.

Distribution Sydney area: Blue Mountains and Wollemi.

Select locations: CC: Boorai Ridge, Colo Gorge, Bilpin, Linden, Woodford.

CT: Mt Tomah, Mt Wilson, Lawson, Wentworth Falls, Blackheath, Mt Cameron.

Habitat

Habitat: Rocky ridges, hillsides.

Altitude: 400–1000 m

Annual rainfall: 1000–1400 mm

Typical local abundance: Rare–occasional, groups of 2–20 plants (Menzies & McKee 1959).

Vegetation: Open-forest e.g. with *Eucalyptus sieberi*, *E. piperita*, *E. sclerophylla* and shrubby understorey; ecotone between dry open woodlands and heaths or tall shrublands e.g. with *Eucalyptus sieberi*, *E. piperita*, *Allocasuarina distyla*, *Banksia serrata* (Maryott-Brown & Wilks 1993).

Substrate: Sandy soil on exposed Burrumoko Formation sandstone ridges (Maryott-Brown & Wilks 1993), low nutrients, well-drained.

Exposure:

Conservation

Conservation: A primitive and relic genus with only one species, endemic to the Blue Mountains–Wollemi area; coded 2RCa on national rare species list (ROTAP 1996).

Dendrophthoe vitellina

LORANTHACEAE

Mistletoe

Life history

Growth form: Aerial stem-parasitic, glaucous, pendulous shrub. Attachment usually with an irregular swelling and external runners but with ball-like attachment to smooth-barked trees (Blakely 1925).

Vegetative spread: No.

Longevity:

Primary juvenile period:

Flowers: Yellow to red. Flowering August–January, peak November, probably pollinated by honey-eaters in search of nectar, probably self-pollinated and possibly insect-pollinated (Blakely 1922).

Fruit/seed: Yellow to red fleshy egg-shaped fruit 10–15 mm long; single seed covered with a gluey substance (viscin) and enclosed in thin sac (Blakely 1922).

Dispersal, establishment & growth: Diaspore: fleshy fruit, bird-dispersed. Contact with the host plant by haustoria (Blakely 1925), after initial penetration the haustoria spread rapidly round the host stem interrupting the cambium and killing the distal end (Thoday 1961).

Fire response: Probably killed.

Interaction with other organisms: Foodplant of Brushtail Possum *Trichosurus vulpecula* (Reid 1997). Destructive to young Bloodwoods *Corymbia gummifera* to 2 m high, other host plants include: *Allocasuarina littoralis*, *A. torulosa*, *Hakea dactyloides*, *Persoonia linearis*, *Amyema congener*, *A. miquelii*, *A. pendulum*, *Muellerina celastroides*, *M. encalyptoides*, *Exocarpus cupressiformis*, *Acacia decurrens*, *Corymbia gummifera*, *C. maculata*, *Eucalyptus acmenoides*, *E. laemastoma*, *E. umbra*, *E. paniculata*, *E. piperita*, *E. punctata*, *Angophora bakeri*, *A. laevis*, *A. floribunda*, *A. costata*, *Tristanopsis laurina*, *Tristania neriifolia*, *Callistemon citrinus*, *C. linearis*, *Leptospermum trinervium*, *L. polygalifolium*, *Melaleuca nodosa*, *M. linariifolia*, *M. styphelioides*, *Kunzea ambigua*, *Melia azedarach*, and exotic species (Blakely 1925).

Plant damaged by scale insects *Ceroplastes cerciferus*, *C. rubens*, *Aspidiotus aurantii*; fruits contain copious, very sweet viscin which is suitable for making bird lime (Blakely 1922, 1925).

Nectar eaten by Eastern Spinebill *Acanthorhyncha tenuirostris*, Honey-eaters *Gliciphila melanops*, *Myzomela sanguinolenta*, *Ptilotis sonora*, *Meliornis novae-hollandiae*, White-eye *Zosterops lateralis* (Blakely 1925).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NWS; Qld, Vic.

Distribution Sydney area: Mainly coastal.

Select locations: CC: Grose Vale, Berowra, Hornsby, Meadowbank, The Spit, Vaucluse, Carlton, Glenbrook, Campbelltown, Cambewarra.

Habitat

Habitat: Open-forest.

Altitude: 0–300 m

Annual rainfall: 800–1200 mm

Typical local abundance:

Vegetation: Mainly on trees and shrubs of Myrtaceae.

Substrate:

Exposure:

Conservation

Conservation:

Muellerina celastroides

LORANTHACEAE

Life history

Growth form: Aerial stem-parasitic shrub with external runners.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Greenish red, October–February, peak December–January. Probably self-pollinated and possibly insect-pollinated (Blakely 1922).

Fruit/seed: Green to reddish pear-shaped fruit 7–11 mm long; single seed covered with a gluey substance and enclosed in thin sac (Blakely 1922), ripe mainly March–June.

Dispersal, establishment & growth: Diaspore: fleshy fruit; seed removed from fruit by Mistletoe-bird *Dicaeum hirundinaceum* before eating and voiding unharmed on host plant (Blakely 1922). Attachment and contact with the host plant by haustoria; sometimes the runners are free, swaying in the wind e.g. on *Syncarpia glomulifera*, growing until they make contact with a suitable host; they die in contact with soil; the runners can feed on each other and often fuse together by their own haustoria (Blakely 1922).

Fire response:

Interaction with other organisms: Parasitic on a variety of trees but commonly recorded on *Banksia integrifolia*, *Allocasuarina littoralis*, *A. torulosa*, *Exocarpus cupressiformis*, *Syncarpia glomulifera*, *Synoum glandulosum*. Also recorded on *Astrotricha floccosa*, *Hakea salicifolia*, *Araucaria heterophylla*, *Schinus (molle) areira**, *Robinia pseudoacacia**, *Quercus alba**, *Platinus hybrida**, and apricot and pear trees, as well as on other parasites such as *Dendrophthoe vitellina*, *Muellerina eucalyptoides*. Parasitic on Apricot and Pear trees, as well as on other parasites such as *Dendrophthoe vitellina*, *Muellerina eucalyptoides*. Parasitic on *Nerium oleander** (P. Kubiak pers. comm.), *Acacia melanoxylon* (A. Bofeldt pers. comm.). Plant damaged by scale insects *Ceroplastes cerciferus*, *C. rubens*, *Aspidiotus aurantii* (Blakely 1922).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CT CWS; Qld, Vic.

Distribution Sydney area: Mainly coastal.

Select locations: CC: Terrigal, Berowra Creek, Narrabeen, St Ives, Mosman, Vaucluse, Cronulla, Ingleburn, Bomaderry. CT: Wingello.

Habitat

Habitat: Open-forest and rainforest.

Altitude: 0–800 m **Annual rainfall:** 1000–1400 mm

Typical local abundance: Frequent–rare.

Vegetation: Warm temperate rainforest, cool temperate rainforest, tall open-forest (A. Bofeldt pers. comm.).

Substrate:

Exposure:

Conservation

Conservation: Not known.

Muellerina eucalyptoides**LORANTHACEAE****Life history**

Growth form: Spreading to pendent, glabrous aerial stem-parasitic shrub, with runners. Intermediate species *M. eucalyptoides*–*M. celastroides* often occur on exotic tree species and it is considered likely that *M. eucalyptoides* and *M. celastroides* have attained a degree of reproductive isolation after specialisation for myrtaceous and non-myrtaceous hosts respectively (Barlow 1971). Both mistletoes are commonly found together and sometimes show double parasitism.

Vegetative spread: Runners.

Longevity:

Primary juvenile period:

Flowers: Greenish red, tubular, December–March. Probably self-pollinated and possibly insect-pollinated (Blakely 1922).

Fruit/seed: Yellowish, pear-shaped 8–15 mm long; single seed covered with a gluey substance (viscin) and enclosed in thin sac (Blakely 1922), mature April–October.

Dispersal, establishment & growth: Diaspore: fleshy fruit. Bird and bat-dispersed (Blakely 1922). Attachment and contact with the host plant by haustoria (Blakely 1922).

Fire response: Resprouted after low to medium intensity fire (1/94) at Lane Cove, with host canopy less than 100% scorched (P. Kubiak pers. comm.).

Interaction with other organisms: Usually parasitic on stems of *Eucalyptus* species including *E. tereticornis*, *E. saligna*, *E. paniculata*, *E. eugenioides*, *E. sieberi*, *E. piperita*, *E. agglomerata*, *E. punctata*, *E. viminalis*, *E. haemastoma*, *E. squamosa*, *E. resiniifera*, *E. umbra*, *E. amplifolia*, *E. baueriana*, *E. sideroxylon*, *E. siderophloia*, *E. crebra*, *E. longifolia*, *E. acmeuoides*.

Foodplant of Greater Glider *Petauroides volans* and Ringtail Possum *Pseudocheirus peregrinus* (Reid 1997). Foodplant of butterfly caterpillars *Ogyris abrota* and *Delias harpalyce* (Coupur & Coupur 1992). Larvae of jewel beetle *Stigmodera producta* reported to develop in the stems near Gosford (Hawkeswood 1982, 1987). Fruit eaten by Crimson Rosella *Platycercus elegans* (Lepschi 1993). Fruit/seeds eaten by Flying Fox *Pteropus rubicollis*; fruits contain copious viscin (a sticky substance) which is suitable for making bird lime (Blakely 1922). Collection of caterpillars *Delias nigrina* seen on plant, noisy minor *Manorina melanocephala* visited flower for nectar (P. Kubiak pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., S.A.

Distribution Sydney area: Widespread.

Select locations: CC: Culoul Range, Cowan, Wahrenonga, Manly, Ermington, Blacktown, Glenbrook, Razorback, Picton, Albion Park, Berry. CT: Mt Wilson, Jenolan Caves, Orange, Hilltop, Wombeyan Caves.

Habitat

Habitat: Eucalypt woodland and forest.

Altitude: 0–1000 m **Annual rainfall:** 800–1400 mm

Typical local abundance: Frequent–occasional.

Vegetation: Mainly parasitic on species of *Eucalyptus*.

Substrate: Clay soils on shale, basalt, sandy soil on sandstone.

Exposure:

Conservation

Conservation: Conservation status unknown.

Lythrum hyssopifolia

LYTHRACEAE

Hyssop Loosestrife

Life history

Growth form: Spreading or ascending annual herb to 50 cm high.

Vegetative spread: No.

Longevity: 1 year.

Primary juvenile period: Less than 1 year.

Flowers: Pink-mauve-purple, October–February, peak December.

Fruit/seed: Dehiscent capsule, with 25–30 seeds, reflexed against the stem and surrounded by the dried calyx, matures February–April.

Dispersal, establishment & growth: Diaspore: seed, dispersed in mud on cars (Wace 1977). Germinates in autumn and winter and grows through into summer (Cunningham et al. 1981). Mature seed retained on dead plant in California (Zedler & Black 1992).

Fire response: Probably killed.

Interaction with other organisms: Seed in capsules retained on dead plant exposed to herbivory in summer drought when forage less abundant, seed found in rabbit pellets (in California) (Zedler & Black 1992).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., S.A., W.A., temp. regions.

Distribution Sydney area: Mainly Western Sydney, Orange.

Select locations: CC: Wyong, Cabarita, Chester Hill, Glenfield, Narellan, Douglas Park, Kangaroo Valley. CT: Woodford, Milthorpe, Orange. Robertson (P. Kodala pers. comm.).

Habitat

Habitat: Moist places or near water — creekbanks, roadside gutters, pond edges.

Altitude: 0–1000 m **Annual rainfall:** 600–1300 mm

Typical local abundance: Occasional.

Vegetation: Various, sedgeland e.g. with *Typha*, *Juncus usitatus*, *Goodenia paniculata*; woodland e.g. with *Eucalyptus tereticornis*

Substrate: Clay soils from Wianamatta Shale, alluvium. Soil fertile. Watertable mostly high, moisture supply intermittent, fresh. Recorded on saline sites in western NSW (Semple 1993).

Exposure:

Conservation

Conservation: Although widespread in eastern Australia, it is now becoming rare in the Sydney district because of habitat destruction and may be becoming rare elsewhere. Vulnerable in Western Sydney (Benson & McDougall 1991). Reported by Robert Brown to be introduced to Sydney by 1804 (Maiden 1909) but now regarded as native.

Lythrum salicaria

LYTHRACEAE

Purple Loosestrife

Life history**Growth form:** Erect, rhizomatous perennial herb 0.5–1 m high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Deep pink to purple, January–March, peak February.**Fruit/seed:** Capsule dehiscing to release numerous seeds, March–April. Seed weight 0.05 mg, germination 92% within 30 days (in North America) (Shipley & Parent 1991).**Dispersal, establishment & growth:** Diaspore: seed.**Fire response:****Interaction with other organisms:** Seed eaten by Crimson Rosella *Platycercus elegans* (Lepschi 1993). Reported as introduced to America in wool from Australia c. 1910 and has spread extensively along water courses there (Russell 1958).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT ST SWS NWP SWP; Qld, Vic., Tas., S.A., temp. regions.**Distribution Sydney area:** Mainly tablelands.**Select locations:** CC: Maroota, Richmond (1907), Campbelltown (1899), Shoalhaven Head. CT: Cudgegong River, Lidsdale, Glenquarry, Little Hartley, Bathurst, Carcoar, Tuglow Caves, Wingecarribee Swamp, Long Swamp (Kodela et al. 1992).**Habitat****Habitat:** Moist places or near water, often in swamps.**Altitude:** 0–1000 m **Annual rainfall:** 600–1200 mm**Typical local abundance:** Occasional–frequent.**Vegetation:** Wetland vegetation e.g. with *Eleocharis sphacelata*, *Blechnum indicum*, *Schoenoplectus mucronatus*; upland mire (Kodela et al. 1992), e.g. with *Leptospermum obovatum*, *Lycopus australis*, *Lysimachia vulgaris*, *Phragmites australis*.**Substrate:** Alluvial soil and peat (P. Kodela pers. comm.). Watertable mostly high, moisture supply continuous, fresh.**Exposure:****Conservation****Conservation:** Conservation status unknown. *Lythrum salicaria* is sometimes thought to be introduced, however, palaeontological studies from Wingecarribee Swamp indicate that this species is native, and a cosmopolitan water plant (P. Kodela 1996).***Rotala rotundifolia* ***

LYTHRACEAE

Life history**Growth form:** Prostrate creeping herb.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Bright pinkish purple with darker red centre, July–October.**Fruit/seed:****Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to SE Asian mainland, naturalised in western Sydney.**Botanical subregions:** CC.**Distribution Sydney area:** Western Sydney.**Select locations:** CC: Mt Druitt (P. Kodela p.c.), Berkshire Park (1992), Glenbrook Lagoon (1994).

Habitat

Habitat: Edges of open water on ponds, lagoons.
Altitude: 0–200 m **Annual rainfall:** 800–1000 mm
Typical local abundance:
Vegetation: Margins of open water with sedges, grasses and herbs.
Substrate: Open water over clay substrate.
Exposure:

Conservation

Conservation: Often cultivated for aquariums, and only very recently reported as naturalised (1992). Potential for spread in wetlands unknown.

***Cotoneaster franchetii* ***

MALACEAE

Cotoneaster

Life history

Growth form: Semi-deciduous shrub to 3 m high.
Vegetative spread: No.
Longevity:
Primary juvenile period:
Flowers: Pinkish.
Fruit/seed: Orange–red fleshy fruit 8–10 mm long, with 3 seeds, ripe ?July.
Dispersal, establishment & growth: Diaspore: fruit, probably bird-dispersed.
Fire response: ?Resprouted from base after high intensity fire (1/94) at Lane Cove and Narrabeen (P. Kubiak pers. comm.).
Interaction with other organisms:

Distribution

Status/origin: Exotic, native to China.
Botanical subregions: NT CT ST.
Distribution Sydney area: Bathurst.
Select locations: CT: Vittoria (west of Bathurst, 1993).

Habitat

Habitat: Hilltop.
Altitude: 800 m **Annual rainfall:** 800 mm
Typical local abundance: Rare.
Vegetation: Woodland e.g. with *Eucalyptus dives*, *E. macrorhyncha*, *E. dalrympleana*, *E. goniocalyx*.
Substrate:
Exposure:

Conservation

Conservation: Only reported naturalised at one site Vittoria (1993) though often cultivated. Capacity for spread unknown.

***Cotoneaster glaucophyllus* ***

MALACEAE

Cotoneaster

Life history**Growth form:** Erect shrub or small tree.**Vegetative spread:** No.**Longevity:****Primary juvenile period:****Flowers:** White, hairy, November–December. Main local pollinators probably honey bees, flies and native bees (P. Kubiak pers. comm.).**Fruit/seed:** Scarlet or red fleshy fruit (pome) 7–8 mm diam., with 2 seeds, June–November.**Dispersal, establishment & growth:** Diaspore: fruit, bird and possibly mammal-dispersed (Carr et al. 1992). Fruit reported from pellets of Currawongs (Buchanan 1989a).**Fire response:** Resprouted from base after high intensity fire (1/94) at Lane Cove, fruiting within 31 months (P. Kubiak pers. comm.).**Interaction with other organisms:** Flowers visited by native bees, and honey bees for nectar and probably pollen; hoverfly (Syrphidae), 3 fly species (Diptera), a beetle (Mordellidae), butterfly (Lycaenidae) and small black ants feed on nectar (P. Kubiak pers. comm.).**Distribution****Status/origin:** Exotic, native to China. Widely cultivated as ornamental.**Botanical subregions:** SC CC NT CT ST NWS; LHL.**Distribution Sydney area:** Sydney suburbs.**Select locations:** CC: Wilberforce, Cheltenham, Narraweena, Northbridge.**Habitat****Habitat:** Roadsides, open-forest.**Altitude:** 0–400 m **Annual rainfall:** 800–1200 mm**Typical local abundance:** Occasional.**Vegetation:** Open-forest e.g. with *Corymbia eximia*, *Eucalyptus punctata*, *Allocasuarina distyla*.**Substrate:** Sandy soil on sandstone, low nutrients.**Exposure:****Conservation****Conservation:** Occasionally naturalised, and spreading (1997, A.N. Rodd pers. comm.).

Scattered plants occur in the bush but the major seed source in suburban gardens will ensure steady invasion. Consideration should be given to removing garden plants (McLoughlin & Rawling 1990).

***Cotoneaster pannosus* ***

MALACEAE

Cotoneaster

Life history**Growth form:** Shrub 1–3 m high.**Vegetative spread:** No.**Longevity:****Primary juvenile period:****Flowers:** White.**Fruit/seed:** Red fleshy fruit 8 mm diam. with 2 seeds, ripe March–April.**Dispersal, establishment & growth:** Diaspore: fruit, bird and possibly animal-dispersed (Carr et al. 1992), dispersed in mud on cars (Wace 1977).**Fire response:****Interaction with other organisms:** Seed eaten by Crimson Rosella *Platycercus elegans* (Lepschi 1993).**Distribution****Status/origin:** Exotic, introduced as ornamental, native to China.**Botanical subregions:** CC NT CT ST; LHL.**Distribution Sydney area:** Sporadic, widespread.**Select locations:** CC: Bangally Head, Northbridge (1972). CT: Abercrombie Caves (1976), Blayney, Blackheath.

Habitat: Roadsides, disturbed sites, native vegetation.	Habitat
Altitude: 0–1000 m	
Annual rainfall: 800–1200 mm	
Typical local abundance: Occasional.	
Vegetation: Cliff edge heath, scrub or open-forest.	
Substrate: Sandy clay soils on Hawkesbury and Narrabeen sandstone, red earth on limestone.	
Exposure:	
Conservation: Commonly cultivated species, first reported as invading bushland in 1970s and now increasingly spreading into bushland generally near habitation both on Coast and Tablelands (1997, A.N. Rodd pers. comm.).	Conservation

***Crataegus monogyna* ***

MALACEAE

Hawthorn

Growth form: Small tree or large shrub with spines 7–20 mm long.	Life history
Vegetative spread: No (McIntyre et al. 1995).	
Longevity:	
Primary juvenile period:	
Flowers: White or pink, October.	
Fruit/seed: Dark red fleshy fruit (pome) 8–12 mm diam., with 1 seed, February–April.	
Dispersal, establishment & growth: Diaspore: fruit, adapted for dispersal by ingestion (McIntyre et al. 1995), bird and mammal-dispersed (Carr et al. 1992).	
Fire response:	
Interaction with other organisms: Australian herbalists use a tincture to treat coronary heart disease and hypertension. Extracts appear to reduce arterial blood pressure and heart rate according to experiments conducted e.g. in Germany. The berries were gathered by English peasants for sauces (Low 1990). Seed eaten by Galah <i>Cacatua roseicapilla</i> (Lepschi 1993).	

Status/origin: Exotic, native to Europe. Widely cultivated, sometimes planted for hedges.	Distribution
Botanical subregions: CC SC NT CT ST; Vic., S.A.	
Distribution Sydney area: Sporadic.	
Select locations: CC: Appin, Saddleback Mountain (1944), Bowral (1949) CT: Carcoar.	

Habitat: Roadsides.	Habitat
Altitude: 0–700 m	
Annual rainfall: 700–1400 mm	
Typical local abundance: Frequent.	
Vegetation:	
Substrate: Clay loam on shale, medium nutrients.	
Exposure:	
Conservation: Naturalised in cooler areas. Capacity to invade bushland unknown.	Conservation

***Pyracantha angustifolia* ***

MALACEAE

Life history**Growth form:** Stout, spiny shrub to 3 m high.**Vegetative spread:** No.**Longevity:** 50 years.**Primary juvenile period:****Flowers:** White, November–December (J. Molloy pers. comm.).**Fruit/seed:** Yellow to deep orange pome, 5–8 mm diam., March–August (J. Molloy pers. comm.).**Dispersal, establishment & growth:** Diaspore: fruit, bird-dispersed e.g. fruit reported from pellets of Currawongs (Buchanan 1989a). Seed dispersed in mud on cars (Wace 1977).**Fire response:** Resprouted from base after high intensity fire (1/94) at Lane Cove, fruiting within 2.5 years (P. Kubiak pers. comm.).**Interaction with other organisms:** Seed eaten by Sulphur-crested Cockatoo *Cacatua galerita*, Australian King Parrot *Alisterus scapularis*, Crimson Rosella *Platycercus elegans* (Lepschi 1993). Hoverfly (Syrphidae) reported feeding on nectar (P. Kubiak pers. comm.).**Distribution****Status/origin:** Exotic, native to China. Introduced as ornamental.**Botanical subregions:** CC NT NWS.**Distribution Sydney area:** Northern Sydney suburbs, Bathurst area.**Select locations:** CC: Belrose (L.McD), Naremburn, Northbridge (1954) CT: Running Stream, Tarana, Bathurst, Wildes Meadow.**Habitat****Habitat:** Roadsides, waste ground, bushland.**Altitude:** 0–1000 m**Annual rainfall:** 700–1400 mm**Typical local abundance:** Occasional.**Vegetation:** Woodland e.g. with *Eucalyptus bridgesiana*, *E. melliodora*, *E. blakelyi*.**Substrate:** Sandy soils on sandstone, granite, low nutrients. Moist clayey, acid soils (J. Molloy pers. comm.).**Exposure:** Mid shade to full sun. Drought and cold tolerant (J. Molloy pers. comm.).**Conservation****Conservation:** Often cultivated, sometimes naturalised, mainly in Tablelands.

Capable of growing in bushland; does not seem to require high nutrients or lots of light, does not mind competition with native plants.

***Pyracantha crenulata* ***

MALACEAE

Life history**Growth form:** Spiny shrub or small tree.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** White, October.**Fruit/seed:** Dark red to crimson fleshy fruit (pome), 5–8 mm diam., ripe February.**Dispersal, establishment & growth:****Fire response:** Resprouted from base after high intensity fire (1/94) at Lane Cove, with mature fruits in less than 2.5 years (P. Kubiak pers. comm.).**Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to Himalayas.**Botanical subregions:** NC CC NT ST.**Distribution Sydney area:** Sydney suburbs.**Select locations:** CC: Morisset, Forestville, Middle Cove, Ingleburn (1967).

Habitat

Habitat: Roadsides, hillsides, creekbanks.

Altitude: 0–300 m **Annual rainfall:** 800–1400 mm

Typical local abundance: Occasional.

Vegetation: Open-forest e.g. with *Angophora costata*, *Eucalyptus piperita*, *Allocasuarina littoralis*.

Substrate: Sandy soils on sandstone, low nutrients.

Exposure: Full sun.

Conservation

Conservation: Often cultivated. Rarely naturalised, probably as local garden escape, but capable of establishing in relatively undisturbed bush, particularly with nutrient-enriched run-off.

Pyracantha fortuneana* **MALACEAE****Life history**

Growth form: Shrub with stout spines.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: White, November.

Fruit/seed: Scarlet to crimson fleshy fruit (pome), 6–7 mm diam., mature April.

Dispersal, establishment & growth:

Fire response: Resprouted from base after high intensity fire (1/94) at Lane Cove (P. Kubiak pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to China.

Botanical subregions: CT ST.

Distribution Sydney area: Orange area, Robertson plateau (P. Kodela pers. comm.).

Select locations: CT: Brandy Creek (Orange 1980).

Habitat

Habitat:

Altitude: 900 m **Annual rainfall:** 800–1000 mm

Typical local abundance: Frequent.

Vegetation:

Substrate:

Exposure:

Conservation

Conservation: Widely cultivated and occasionally naturalised in Orange area.

Raphiolepis indica *

MALACEAE

Indian Hawthorn

Life history

Growth form: Shrub 1–1.5 m high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** White tinged with pink,**Fruit/seed:** Bluish fleshy fruit (pome), 5–10 mm diam., with 1 or 2 seeds.**Dispersal, establishment & growth:** Diaspore: fruit, bird-dispersed. Fruit reported from pellets of Currawongs (Buchanan 1989a).**Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Exotic, native to Asia. Cultivated as ornamental, particularly in Victorian period.**Botanical subregions:** CC.**Distribution Sydney area:** Sydney suburbs.**Select locations:** CC: Gosford (1971), Manly (R. Buchanan p.c.), Watsons Bay (1955), Hunters Hill, Bellevue Hill (1954).

Habitat

Habitat: Headlands and hillsides.**Altitude:** 0–200 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Rare.**Vegetation:** Scrub.**Substrate:** Shallow soil over sandstone, low nutrients.**Exposure:**

Conservation

Conservation: Occasionally naturalised around old habitation. Not a vigorous invader of bushland.*Sorbus domestica* *

MALACEAE

Service Tree

Life history

Growth form: Tree to 10 m high with shredding bark.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** White,**Fruit/seed:** Greenish fruit 20 mm diam., November.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Exotic, native of Mediterranean. Cultivated as ornamental.**Botanical subregions:** CC.**Distribution Sydney area:** Grose River, Grose Vale.**Select locations:** CC: Grose Vale (1960).

Habitat

Habitat: Riverbank.**Altitude:** 0–100 m**Annual rainfall:** 900 mm**Typical local abundance:****Vegetation:****Substrate:** Deep sandy loam on riverbank.**Exposure:**

Conservation

Conservation: Rarely naturalised, capability of spread unknown.

***Abutilon grandifolium* ***

MALVACEAE

Life history

Growth form: Large spreading, hairy shrub to 2 m high.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Yellow, winter-spring.

Fruit/seed: Segmented fruit 14–15 mm diam., April.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Exotic, native to S America.

Botanical subregions: NC CC CWS SWP; Qld.

Distribution Sydney area: Sydney suburbs.

Select locations: CC: Willoughby, Northbridge (1965), Kings Cross (1987).

Habitat

Habitat: Waste ground, creeks.

Altitude: 0–200 m

Annual rainfall: 1200 mm

Typical local abundance: Rare.

Vegetation:

Substrate: Sandy soil on sandstone, low nutrients.

Exposure:

Conservation

Conservation: Local garden escape found on waste ground, or near creeks.

Abutilon oxycarpum

MALVACEAE

Flannel Weed

Life history

Growth form: Shrub 1.5–2 m high with velvety stems and leaves. Two varieties are sometimes separated on leaf shape and hairiness (Harden 1990).

Vegetative spread: No.

Longevity: 4–10 years (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Yellow, September–April.

Fruit/seed: Dry brown capsules 7–9 mm long, with black seeds, March–June.

Dispersal, establishment & growth: Diaspore: seed. Pioneer species of gaps in rainforest (A. Bofeldt & M. Robinson pers. comm.).

Fire response: Killed, recruitment from seed stimulated by fire (A. Bofeldt pers. comm.).

Interaction with other organisms: Leaves eaten by Hibiscus Beetle, Jewel Beetle (A. Bofeldt pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT NWS CWS NWP SWP; Qld, ?Vic., N.T., S.A., W.A.

Distribution Sydney area: Western Sydney, Illawarra.

Select locations: CC: Grose Vale (1910), Nortons Basin, Razorback, Cobbitty, Mt Kembla, Albion Park, Cambewarra.

Habitat

Habitat: Rocky hill slopes, creekbanks.

Altitude: 0–300 m **Annual rainfall:** 700–1400 mm

Typical local abundance: Occasional.

Vegetation: Dry rainforest e.g. with *Clerodendrum tomentosum*, *Hibiscus heterophylla*, *Melaleuca styphelioides*; or moist eucalypt forest e.g. with *Eucalyptus tereticornis*, *Acacia parvipinnula*; or riparian forest e.g. with *Casuarina cunninghamii*.

Substrate: Clay loam on shale, calcareous sandstone or alluvium, medium nutrients. Budgong Sandstone, Bumbo Latite in Illawarra (M. Robinson pers. comm.).

Exposure: Mid shade to full sun (M. Robinson pers. comm.).

Conservation

Conservation: Dry rainforest habitats are susceptible to weed invasion. Not well conserved in Illawarra, reported from Budderoo NP, Macquarie Pass NP (A. Bofeldt pers. comm.). Conservation status elsewhere unknown.

Gynatrix pulchella

MALVACEAE

Hempbush

Life history

Growth form: Spreading shrub to 3 m high, often covered with stellate hairs.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Cream to white, male and female flowers on different plants, October–November.

Fruit/seed: Hairy capsule 5 mm diam., October–January.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC SC CT ST; Vic., Tas.

Distribution Sydney area:

Select locations: CC: St Marys, Nepean River (1899), Yerranderie. CT: Oberon, Katoomba (1967), Jenolan Caves, Kowmung River, Church Creek, Bullio to Wombeyan (1905).

Habitat**Habitat:** Riverbanks.**Altitude:** 0–1000 m**Annual rainfall:** 800–1100 mm**Typical local abundance:** Frequent.**Vegetation:** Moist eucalypt forest e.g. with *Eucalyptus cypellocarpa*, *E. piperita*, *Syncarpia glomulifera*, *Angophora costata*; rainforest margins.**Substrate:** Gravelly alluvium and on metamorphic rocks, limestone, medium nutrients.**Exposure:****Conservation****Conservation:** Northern geographical limit at Oberon. Conservation status unknown.***Hibiscus diversifolius*****MALVACEAE**

Swamp Hibiscus

Life history**Growth form:** Shrub 1–2 m high, with hairy, prickly stems; leaves 3–5 lobed. Sometimes semi-aquatic.**Vegetative spread:****Longevity:** 3–10 years (A. Bofeldt pers. comm.).**Primary juvenile period:****Flowers:** Yellow with a red spot, September–March (A. Bofeldt pers. comm.).**Fruit/seed:** Hairy capsule 20 mm long. Mature December–June, remains viable for some years in storage (A. Bofeldt pers. comm.).**Dispersal, establishment & growth:** Diaspore: seed, soil-stored seedbank, possibly with dormancy mechanism. Germination stimulated by fire and disturbance (A. Bofeldt pers. comm.).**Fire response:** Probably killed, recruited from soil-stored seed after high-intensity fire (1/94) at Narrabeen.**Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC; LHI, Qld, N.G., Philipp., Pac. Is, C & S Amer., Afr.**Distribution Sydney area:** Coastal Sydney.**Select locations:** CC: Narrabeen Lagoon, Botany Bay (1898), Bunnerong. Thirroul, Bellambi Creek (A. Bofeldt p.c.).**Habitat****Habitat:** Low swampy coastal areas.**Altitude:** 0–50 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Frequent.**Vegetation:** *Casuarina glauca* forest.**Substrate:** Sand dunes, sandy alluvium, brackish water.**Exposure:** Frost sensitive. Full sun to light shade (A. Bofeldt pers. comm.).**Conservation****Conservation:** Rare and poorly conserved. Endangered in Illawarra where there are only two unprotected populations (A. Bofeldt pers. comm.).

Hibiscus heterophyllus* subsp. *heterophyllus

MALVACEAE

Native Rosella

Life history

Growth form: Shrub or small tree, with prickly stems. Usually 5–10 m in Illawarra (A. Bofeldt pers. comm.).

Vegetative spread: No (A. Bofeldt pers. comm.).

Longevity: 10–40 years (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: White, pale pink or yellow, November–January.

Fruit/seed: Capsule 20 mm long, mature December–January.

Dispersal, establishment & growth: Diaspore: seed. Germination stimulated by disturbance, 1–6 weeks, coloniser (A. Bofeldt pers. comm.).

Fire response: Killed, vigorous recruitment from seed stimulated by fire (A. Bofeldt & M. Robinson pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC NT; Qld.

Distribution Sydney area: Widespread.

Select locations: CC: Ourimbah, Colo River, Kurrajong, Nortons Basin, Cobbitty, Dapto, Macquarie Pass, Albion Park, Kiama.

Habitat

Habitat: Sheltered sites, gullies, riverbanks. Well-drained slopes and ridges.

Altitude: 0–200 m **Annual rainfall:** 800–1600 mm

Typical local abundance: Frequent–occasional.

Vegetation: Subtropical rainforest and subtropical/warm temperate rainforest intergrades (A. Bofeldt & M. Robinson pers. comm.). Dry rainforest e.g. with *Abutilon oxycarpum*; rainforest/eucalypt forest margins e.g. with *Acacia irrorata*, *Syncarpia glomulifera*; riverbanks.

Substrate: Sandy alluvial soil, or clay soil from basalt, shale. Medium to high nutrients, well-drained. Bumbo Latite, Budgong Sandstone in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Light shade to full sun (A. Bofeldt pers. comm.).

Conservation

Conservation: Kiama is southern geographical limit (Mills 1996), conservation status unknown.

Hibiscus splendens

MALVACEAE

Life history

Growth form: Tall shrub or small tree to 6 m high, with dense velvety hairy covering.

Vegetative spread: No (A. Bofeldt pers. comm.).

Longevity: 5–10 years (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Pink, October–December.

Fruit/seed: Capsule 30 mm long, with dense covering of straw-coloured hairs, August.

Dispersal, establishment & growth: Diaspore seed, germinates 1–3 weeks, stored seed viable for long period (A. Bofeldt pers. comm.).

Fire response: Killed, recruitment from seed stimulated by fire (A. Bofeldt pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC; Qld.

Distribution Sydney area: Northern Illawarra.

Select locations: CC: Bulli, Towradgi Creek (N of Wollongong).

Habitat**Habitat:** Rocky slopes, ridges, creekbanks, base of escarpment.**Altitude:** 0–100 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Frequent.**Vegetation:** Rainforest regrowth and open-forest understorey (A. Bofeldt pers. comm.).**Substrate:** Sandy clay loams, alluvium, low to medium nutrient soils, well-drained (A. Bofeldt pers. comm.).**Exposure:** High light levels, some shade tolerance (A. Bofeldt pers. comm.).**Conservation****Conservation:** Southern geographical limit at Towradgi. Regionally rare in Illawarra region (Mills 1988), small populations in lowland habitat endangered there (A. Bofeldt comm.).***Hibiscus sturtii* var. *sturtii*****MALVACEAE**

Hill Hibiscus

Life history**Growth form:** Subshrub to 30 cm high, sometimes prostrate.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Purple, pink or white,**Fruit/seed:** Densely hairy capsule 10 mm long.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC; Qld.**Distribution Sydney area:** Burragorang Valley.**Select locations:** CC: Beloon Pass (Wanganderry Tableland), Jooriland.**Habitat****Habitat:** Rocky hillsides.**Altitude:** 300–600 m**Annual rainfall:** 800–900 mm**Typical local abundance:****Vegetation:** Woodland with *Acacia binervia*, *Callitris rhomboidea* (Douglas Scarp woodland of Fisher, Ryan & Lembit 1995).**Substrate:** Sandy soil over sandstone.**Exposure:****Conservation****Conservation:** Locally restricted, conservation status unknown.

Hibiscus trionum

MALVACEAE

Bladder Ketmia

Life history

Growth form: Annual or short-lived perennial herb. Some botanists recognise two taxa within this species (Harden 1990).

Vegetative spread: No (McIntyre et al. 1995).

Longevity: 1–2 years.

Primary juvenile period:

Flowers: Yellow, cream or white with dark purple spot, November–May.

Fruit/seed: Capsule 15–20 mm long, November–May.

Dispersal, establishment & growth: Diaspore: seed, no particular mechanism for dispersal (McIntyre et al. 1995).

Fire response: Probably killed.

Interaction with other organisms:

Distribution

Status/origin: Naturalised exotic in the Sydney region, but native to northern and inland Australia.

Botanical subregions: *NC *CC *SC *NT *CT *ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., N.T., S.A., W.A., warm regions.

Distribution Sydney area: Widespread.

Select locations: CC: Cowan, Collaroy, Penrith, Menange Park, Otford (1890), Austinmer, Lake Illawarra. CT: Bathurst.

Habitat

Habitat: Roadsides, grasslands.

Altitude: 0–700 m

Annual rainfall: 600–1200 mm

Typical local abundance: Frequent.

Vegetation: Roadside weeds e.g. with *Paspalum dilatatum*, *Modiola caroliniana*, *Cynodon dactylon*. Hind-dune forest (A. Bofeldt & M. Robinson pers. comm.)

Substrate: Sandy soil over sandstone, alluvium, shale.

Exposure:

Conservation

Conservation: A widespread weed of habitation and cultivation in eastern Australia and almost certainly introduced, though from where is unknown. A different variety of the species is indigenous to northern and inland Australia (Harden 1990). Not conserved in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Howittia trilocularis

MALVACEAE

Life history

Growth form: Shrub 1–3 m high.

Vegetative spread: No (A. Bofeldt pers. comm.)

Longevity: 5–20 years (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Purple, July–April, peak September–October.

Fruit/seed: Capsule 8 mm diam., November–June.

Dispersal, establishment & growth: Diaspore: seed, long-lived, germination erratic 1–4 months (A. Bofeldt pers. comm.).

Fire response: Probably killed, recruitment from seed stimulated by fire (A. Bofeldt pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT CWS; Vic., S.A.

Distribution Sydney area:

Select locations: CC: Morisset, Olney SF, Ourimbah, Killara, Mountain Lagoon, Kangaroo Valley. CT: Rylstone, Blackheath, Wentworth Falls, Bundanoon, Wingello.

Habitat

Habitat: Steep slopes.

Altitude: 0–1000 m

Annual rainfall: 1000–1400 mm

Typical local abundance: Occasional–frequent.

Vegetation: Subtropical/warm tropical rainforest margins, ecotone with open-forest (A. Bofeldt pers. comm.); moist tall open-forest e.g. with *Eucalyptus saligna*.

Substrate: Sandy soil on sandstone, Narrabeen Group, clay soil on basalt, medium–high nutrients, well-drained.

Exposure: Mid-shade to full sun (A. Bofeldt pers. comm.)

Conservation

Conservation: Widespread but not common, conservation status unknown. Rare in Illawarra but conserved (A. Bofeldt pers. comm.)

***Lagunaria patersonii* ***

MALVACEAE

Norfolk Island Hibiscus

Life history

Growth form: Tree to 15 m high.

Vegetative spread: No.

Longevity: Possibly 50 years.

Primary juvenile period:

Flowers: Pale pink to mauve, December.

Fruit/seed: Egg-shaped capsule 2–3 cm long, covered with fine irritant spicules; seeds 7 mm long, red, fleshy, April–July.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms: Fruit reported from pellets of Currawongs (Buchanan 1989a).

Distribution

Status/origin: Exotic, native to Norfolk Island, Lord Howe Island, introduced as ornamental.

Botanical subregions: *NC *CC; ?*Qld, *S.A., LHI, NI.

Distribution Sydney area: Coast, Barrenjoey to Shellharbour.

Select locations: CC: Barrenjoey (L.McD.), Avalon Beach (M. Walters p.c.), Curl Curl, Campbelltown, Wollongong, Shellharbour (1965).

Habitat

Habitat: Headlands, sea cliffs, estuaries, steep banks.

Altitude: 0–200 m

Annual rainfall: 800–1400 mm

Typical local abundance: Occasional.

Vegetation: Littoral rainforest; *Casuarina glauca* swamp forest (A. Bofeldt & M. Robinson pers. comm.).

Substrate: Clay soils on steep banks. Quaternary alluvium, Blow Hole Latite in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Full sun to mid-shade.

Conservation

Conservation: Locally naturalised in coastal habitats of Illawarra (A. Bofeldt & M. Robinson pers. comm.).

***Lavatera arborea* ***

MALVACEAE

Tree Mallow

Life history**Growth form:** Hairy herb 1–3 m high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Lilac with purple veins at base, August–November.**Fruit/seed:** Fruit of 6–8 segments.**Dispersal, establishment & growth:** Diaspore: segment of fruit.**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to Europe.**Botanical subregions:** CC; Vic., S.A.**Distribution Sydney area:****Select locations:** CC: Maroubra (1953), Leumeah (1966), Campbelltown (1969), Werombi (1948).**Habitat****Habitat:** Sea coast, weedy areas.**Altitude:** 0–300 m**Annual rainfall:** 700–1200 mm**Typical local abundance:****Vegetation:****Substrate:****Exposure:****Conservation****Conservation:** Localised garden escape. Capability of spread unknown.***Lavatera cretica* ***

MALVACEAE

Cretan Hollyhock

Life history**Growth form:** Hairy herb to 1.5 m high.**Vegetative spread:** No.**Longevity:** Probably annual.**Primary juvenile period:** Less than 1 year.**Flowers:** Lilac-pink.**Fruit/seed:** Fruit of 7–11 segments, October–November.**Dispersal, establishment & growth:** Diaspore: segment of fruit.**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to Mediterranean.**Botanical subregions:** CC; Vic., S.A., W.A.**Distribution Sydney area:** Inner western suburbs.**Select locations:** CC: Lidcombe (1960), Drummoyne (1975).**Habitat****Habitat:** Roadside, waste ground.**Altitude:** 0–200 m**Annual rainfall:** 1000–1200 mm**Typical local abundance:** Frequent.**Vegetation:****Substrate:****Exposure:****Conservation****Conservation:** Occasionally naturalised on disturbed sites in inner western Sydney suburbs. Unlikely to invade bushland.

Lavatera trimestris *

MALVACEAE

Life history

Growth form: Hairy herb to 50 cm high.
Vegetative spread:
Longevity:
Primary juvenile period:
Flowers: White, pink, red or lilac, October–November.
Fruit/seed: Segmented fruit 7–14 mm diam,
Dispersal, establishment & growth: Diaspore: segment of fruit.
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Exotic, native to Mediterranean.
Botanical subregions: CC.
Distribution Sydney area:
Select locations: CC: Wyong (1948).

Habitat

Habitat: Garden.
Altitude: 0–200 m **Annual rainfall:** 1200 mm
Typical local abundance:
Vegetation:
Substrate:
Exposure:

Conservation

Conservation: Reported as a garden weed at Wyong in 1948. No subsequent records.
Does not appear to have naturalised.

Malva neglecta *

MALVACEAE

Dwarf Mallow

Life history

Growth form: Prostrate herb.
Vegetative spread: No.
Longevity: 1 year.
Primary juvenile period: Less than 1 year.
Flowers: Pink to pinkish lilac, September–February.
Fruit/seed: Hairy disc-shaped fruit, November.
Dispersal, establishment & growth:
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Exotic, native to Mediterranean.
Botanical subregions: CC SC NT CT ST; Vic., Tas.
Distribution Sydney area: Sporadic.
Select locations: CC: Flemington, Campbelltown (1929) CT: Robertson.

Habitat

Habitat: Saleyards, stockyards.
Altitude: 0–600 m **Annual rainfall:** 700–1600 mm
Typical local abundance:
Vegetation:
Substrate: Clay soil associated with animal yards, high nutrients.
Exposure:

Conservation

Conservation: Recorded occasionally from stockyards, though probably extinct at Flemington now. Unlikely to invade bushland.

***Malva nicaeensis* ***

MALVACEAE

Mallow of Nice

Life history**Growth form:** Annual or short-lived perennial herb.**Vegetative spread:** No.**Longevity:** 1–2 years.**Primary juvenile period:****Flowers:** Light purple, September–January.**Fruit/seed:** Disc-shaped fruit 5–8 mm diam., October–January.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to Mediterranean.**Botanical subregions:** CC CT; Vic., Tas., S.A.**Distribution Sydney area:** Sporadic.**Select locations:** CC: Alexandria (1912), Cooks River (1912), Concord, Flemington, Penrith.

CT: Bathurst (1901), Mittagong.

Habitat**Habitat:** Railways, saleyards.**Altitude:** 0–800 m**Annual rainfall:** 600–1200 mm**Typical local abundance:****Vegetation:** With weeds of disturbed places.**Substrate:****Exposure:****Conservation****Conservation:** Uncommon weed with sporadic occurrences.***Malva parviflora* ***

MALVACEAE

Small-flowered Mallow

Life history**Growth form:** Erect or prostrate herb.**Vegetative spread:** No.**Longevity:** 6 months.**Primary juvenile period:** 4 months.**Flowers:** White or pink, August–June, peak September–October.**Fruit/seed:** Disc-shaped brown fruit 7–8 mm diam., August–March, peak October.**Dispersal, establishment & growth:** Diaspore: fruit. Dispersed in mud on cars (Wace 1977).**Fire response:** Possibly killed after high intensity fire (1/94) at Lane Cove, seedlings with green fruit in less than 3 months (P. Kubiak pers. comm.).**Interaction with other organisms:** Foodplant of Stubble Quail *Coturnix pectoralis* (Barker & Vestjens 1989, 1990).**Distribution****Status/origin:** Exotic, native to Mediterranean.**Botanical subregions:** NC CC SC CT ST SWP NFWP; LHI, Qld, Vic., Tas., N.T., S.A., W.A.**Distribution Sydney area:** Sydney suburbs.**Select locations:** CC: Beecroft, Glebe Point, Centennial Park (1901), Cooks River (1912), Cabarita, Flemington, Cabramatta, Richmond, Campbelltown, Lake Illawarra. CT: Robertson district.**Habitat****Habitat:** Roadsides, creekbanks, gardens.**Altitude:** 0–700 m**Annual rainfall:** 700–1200 mm**Typical local abundance:** Occasional.**Vegetation:****Substrate:** Sandy soil on sandstone, alluvium.**Exposure:****Conservation****Conservation:** Minor weed of disturbed sites.

***Malvastrum americanum* ***

MALVACEAE

Spiked Malvastrum

Life history**Growth form:** Annual or perennial herb to 60 cm high, sometimes with a woody base.**Vegetative spread:** No.**Longevity:****Primary juvenile period:****Flowers:** Yellow to orange, March.**Fruit/seed:** Fruit 4–5 mm diam., of 8–12 segments, March.**Dispersal, establishment & growth:** Diaspore: segment of fruit.**Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to America.**Botanical subregions:** NC CC NWS CWS NWP NFWP SFWP; Qld, Vic., Tas., N.T., S.A., W.A.**Distribution Sydney area:** Saleyards, grassland.**Select locations:** CC: Flemington (1969), Camden (1976).**Habitat****Habitat:****Altitude:** 0–300 m**Annual rainfall:** 700–1100 mm**Typical local abundance:****Vegetation:** Grassland e.g. with *Sida rhombifolia**.**Substrate:****Exposure:****Conservation****Conservation:** Minor weed.***Modiola caroliniana* ***

MALVACEAE

Red-flowered Mallow

Life history**Growth form:** Prostrate herb.**Vegetative spread:** Limited spread rooting at nodes.**Longevity:****Primary juvenile period:****Flowers:** Red or orange-red, August–April, peak October. Honeybees and native bees probably major local pollinators (P. Kubiak pers. comm.).**Fruit/seed:** Capsule 7–9 mm diam., October–December.**Dispersal, establishment & growth:** No particular morphology for dispersal (McIntyre et al. 1995), dispersed in mud on cars (Wace 1977).**Fire response:** Possibly killed after high intensity fire (1/94) at Lane Cove, seedlings shedding seed in less than 1 year (P. Kubiak pers. comm.).**Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to S America.**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., Tas., S.A., W.A.**Distribution Sydney area:** Widespread.**Select locations:** CC: Hornsby, Wahroonga, Centennial Park (1969), Colyton, Badgers Creek, Shellharbour, Kangaroo Valley. CT: Mt Kindarun, Hartley, Jenolan Caves, O'Connell, Orange, Robertson (P.Kodala p.c.).**Habitat****Habitat:** Gardens, waste places, roadsides.**Altitude:** 0–1000 m**Annual rainfall:** 700–1400 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Grassland, lawn.**Substrate:** Clay soil on shale, basalt, medium–high nutrients. Recorded on saline sites in western NSW (Semple 1993).**Exposure:** Full sun.**Conservation****Conservation:** Weed of gardens and waste places, unlikely to invade bushland.

***Pavonia hastata* ***

MALVACEAE

Life history**Growth form:** Spreading shrub to 1.5 m high.**Vegetative spread:****Longevity:** Short-lived 5–10 years (A. Bofeldt pers. comm.).**Primary juvenile period:****Flowers:** Reddish purple with dark base. Some flowers remain closed and are self-pollinating (cleistogamous).**Fruit/seed:** Dry hairy fruit 8 mm diam., splitting to release seeds, January–March.**Dispersal, establishment & growth:****Fire response:** Probably killed after high intensity fire (1/94) at Lane Cove, seedlings shedding seed within 16 months, peak of post-fire fruiting in 2 years (P. Kubiak pers. comm.).**Interaction with other organisms:** Foodplant of butterfly *Vanessa kershawi* (Hawkeswood 1981).**Distribution****Status/origin:** Exotic, native to S America.**Botanical subregions:** NC CC NT NWS CWS SWS SWP; Qld.**Distribution Sydney area:****Select locations:** CC: Killcare, Thornleigh, Parramatta River (1888), Silverwater, Cattai, Richmond, Leumeah, Glenbrook.**Habitat****Habitat:** Disturbed edges of bushland, roadsides.**Altitude:** 0–300 m**Annual rainfall:** 700–1200 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Open-forest e.g. with *Eucalyptus sparsifolia*, *Syncarpia glomulifera*, *Eucalyptus piperita*, *Angophora costata*; and woodland e.g. with *Eucalyptus crebra*.**Substrate:** Clay soils on Wianamatta Shale, or sandy soil on sandstone, medium nutrients.**Exposure:** Light shade–full sun.**Conservation****Conservation:** Naturalised exotic though reported by Robert Brown (c. 1804) (Bentham 1863).***Sida corrugata***

MALVACEAE

Life history**Growth form:** Prostrate to decumbent perennial with thick root stock, spreading to 30 cm diam.**Vegetative spread:** No.**Longevity:****Primary juvenile period:****Flowers:** Yellowish, October–April (peak March).**Fruit/seed:** Dry segmented fruit 5 mm diam., splitting to release segments, January–April.**Dispersal, establishment & growth:****Fire response:****Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC NT CT NWS CWSS SWS NWP SWP; Qld, ?Vic., N.T., S.A., W.A.**Distribution Sydney area:** Western Sydney, Bathurst.**Select locations:** CC: Berkshire Park, Ingleburn, Nortons Basin, Campbelltown, Camden, Burragorang Valley. CT: Wyagdon, Perth.**Habitat****Habitat:** Grassy woodland.**Altitude:** 0–1000 m**Annual rainfall:** 600–800 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Woodland e.g. with *Eucalyptus moluccana*, *E. crebra*, *E. tereticornis* with grassy understorey.**Substrate:** Clay soils on Wianamatta Shale, granite, Permian sandstone, medium nutrients.**Exposure:** Full sun–light shade.**Conservation****Conservation:** Conservation status unknown.

***Sida rhombifolia* ***

MALVACEAE

Paddy's Lucerne

Life history

Growth form: Erect subshrub to 1 m high, with deep robust taproot. Reported to 2 m high in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Vegetative spread: No.

Longevity:

Primary juvenile period: Less than 1 year (Parsons & Cuthbertson 1992).

Flowers: Yellow to pale orange, flowers December–May, peak April. Native bees and honey bees may be chief local pollinators, with hoverflies and small butterflies playing a lesser role; in summer flowers open for a couple of hours around midday (P. Kubiak pers. comm.).

Fruit/seed: Dry segmented fruit 5–6 mm diam., splitting to release 9–12 barbed segments, December–May, peak April.

Dispersal, establishment & growth: Diaspore: fruit segments. Dispersed in mud or by attachment to wool, fur, clothing, or by water; seed hard-coated: dormancy broken by soil acids, bacteria and temperature fluctuations (Parsons & Cuthbertson 1992).

Fire response: Mostly killed by high intensity fire (1/94) at Lane Cove, a few plants resprouting after low intensity burning; seedlings maturing with seeds shed within 7 months (P. Kubiak pers. comm.).

Interaction with other organisms: Foodplant of Stubble Quail *Coturnix pectoralis* (Barker & Vestjens 1989, 1990). Young growth is freely eaten by stock but old plants become woody and objectionable (A.A. Hamilton 1909 Herb. note). Chrysomelid beetle *Calligrapha pantherina* released in NSW (1990) for biological control (Parsons & Cuthbertson 1992).

Distribution

Status/origin: Exotic, native to tropical regions.

Botanical subregions: NC CC SC NWP SWP; Qld, N.T.

Distribution Sydney area: Widespread at low elevations.

Select locations: CC: Mooney Mooney, Warriewood (P. Kodela p.c.), Beecroft, Forestville (L.McD.), Mosman (1904), Flemington, Leppington, Mt Annan, Springwood (1888), Wollongong, Albion Park.

Habitat

Habitat: Roadsides, waste ground.

Altitude: 0–300 m

Annual rainfall: 700–1400 mm

Typical local abundance: Frequent.

Vegetation: Open-forest e.g. with *Eucalyptus paniculata*, *E. resinifera*, *Angophora costata*; and woodland e.g. with *Eucalyptus moluccana*, *E. tereticornis*.

Substrate: Clay soils on Wianamatta Shale, volcanic necks; Berry Siltstone, Budgegong Sandstone in Illawarra (A. Bofeldt & M. Robinson pers. comm.), medium nutrients, well-drained.

Exposure: Full sun.

Conservation

Conservation: Widespread weed in gardens, roadsides and waste places.

Invasive of bushland (McRae 1990).

Sida spinosa

MALVACEAE

Life history

Growth form: Erect subshrub to 1 m high.**Vegetative spread:****Longevity:****Primary juvenile period:****Flowers:** Small,**Fruit/seed:** Dry segmented fruit 4–6 mm diam., splitting into segments, January–April.**Dispersal, establishment & growth:** Diaspore: fruit segments.**Fire response:****Interaction with other organisms:**

Distribution

Status/origin: Native.**Botanical subregions:** NC CC NWS; Qld, NT.**Distribution Sydney area:** Western Sydney.**Select locations:** CC: Greystanes, Holsworthy, Leppington (1984).

Habitat

Habitat:**Altitude:** 0–200 m**Annual rainfall:** 800–1000 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Woodland e.g. with *Eucalyptus moluccana*, *E. tereticornis*.**Substrate:** Clay soils on Wianamatta Shale, medium nutrients.**Exposure:**

Conservation

Conservation: Leppington is southern geographical limit. Conservation status unknown.*Ibicella lutea* *

MARTYNIACEAE

Yellow-flowered Devil's Claw

Life history

Growth form: Herb to 30 cm high, with hollow glandular-hairy stems exuding a slimy, sticky sap and a diffuse root system, with no main taproot (Parsons & Cuthbertson 1992).**Vegetative spread:** No.**Longevity:** 1 year.**Primary juvenile period:** Less than 1 year.**Flowers:** Yellow with purple-red spots, February–March.**Fruit/seed:** Woody, spiny capsule 5–15 cm long, with curled horns 5–12 cm long; wrinkled seeds 6–12 mm long, February–March.**Dispersal, establishment & growth:** Diaspore: fruit.**Fire response:****Interaction with other organisms:** Easily destroyed by cultivation before flowering; attacked by larvae of moth *Heliothis armigera*; mouths and feet of stock injured by 'claws'; young fruit eaten as pickles by American Indians, seeds eaten by Cockatoos (Parsons & Cuthbertson 1992).

Distribution

Status/origin: Exotic, native to S America.**Botanical subregions:** CC CWS SWS SWP; Qld.**Distribution Sydney area:** Sporadic.**Select locations:** CC: Hornsby (1923), Windsor (1918), Flemington.

Habitat

Habitat: Saleyards.**Altitude:** 0–300 m**Annual rainfall:** 800–1200 mm**Typical local abundance:****Vegetation:****Substrate:****Exposure:**

Conservation

Conservation: Weed of pastures and cultivation mainly on Western Slopes in NSW, rare in Sydney area.

Proboscidea louisianica* **MARTYNIACEAE**

Purple-flowered Devil's Claw

Life history

Growth form: Herb to 30 cm high, with hollow glandular-hairy stems exuding a slimy, sticky sap and a diffuse root system, with no main taproot (Parsons & Cuthbertson 1992). Spreads along ground up to 1 m distance, resembling a pumpkin vine (Whittet 1958).

Vegetative spread: No.

Longevity: Less than 1 year.

Primary juvenile period: Less than 1 year.

Flowers: Cream to pale reddish-purple, January–April.

Fruit/seed: Very hard woody capsule 8–10 cm long, with curled horns 10–25 cm long, January–April.

Dispersal, establishment & growth: Diaspore: fruit. Hardy, summer-growing, even in low rainfall areas (Whittet 1958).

Fire response:

Interaction with other organisms: Easily destroyed by cultivation before flowering; mouths and feet of stock injured by 'claws'; young fruit eaten as pickles by American Indians, seeds eaten by Cockatoos (Parsons & Cuthbertson 1992).

Distribution

Status/origin: Exotic, native to N America. Probably introduced as ornamental or for botanical interest, earliest record is Adelaide Botanic Gardens 1858; considered naturalised in Victoria by 1882 (Parsons & Cuthbertson 1992).

Botanical subregions: CC CT NWS CWS SWS NWP SWP SFWP; S.A., W.A.

Distribution Sydney area:

Select locations: CC: Bexley (1965). CT: Bathurst district (1972).

Habitat

Habitat: Garden.

Altitude: 0–800 m

Annual rainfall: 600–1000 mm

Typical local abundance:

Vegetation:

Substrate: Mainly on highly fertile soils (Parsons & Cuthbertson 1992). Recorded on saline sites in western NSW (Semple 1993).

Exposure:

Conservation

Conservation: Widely naturalised in inland districts and reported from garden in Sydney area. Declared noxious weed in some areas of NSW (Harden 1992).

Dysoxylum fraserianum

Rosewood

MELIACEAE**Life history****Growth form:** Medium to large tree.**Vegetative spread:** No.**Longevity:** Long-lived (A. Bofeldt pers. comm.).**Primary juvenile period:****Flowers:** White, April–June.**Fruit/seed:** Egg-shaped capsule 15–25 mm long with up to 8 red-coated seeds (with reddish aril), about 7 mm long.**Dispersal, establishment & growth:** Diaspore: Seed, short-lived. Probably no soil-stored seedbank, germination of fresh seed takes 3–23 weeks with 70–100% germination (difficult to store dry because of susceptibility to mould) (Floyd 1989). Germination 4–8 weeks (A. Bofeldt pers. comm.).**Fire response:** Resprouts from base (R. Payne pers. comm.).**Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC CWS; Qld.**Distribution Sydney area:** Wyong.**Select locations:** CC: Little Jillyby FR (Floyd 1989), Wyong River.**Habitat****Habitat:** Gullies, sheltered slopes (A. Bofeldt pers. comm.).**Altitude:** 0–200 m**Annual rainfall:** 1200 mm**Typical local abundance:** Rare–occasional.**Vegetation:** Subtropical gallery rainforest.**Substrate:** Clay soils on riverine alluvium, medium nutrients. Also alluvial sands (R. Payne pers. comm.).**Exposure:** Tolerates full shade (A. Bofeldt pers. comm.).**Conservation****Conservation:** Wyong is southern geographical limit, conservation status unknown. Not conserved on Central Coast (R. Payne pers. comm.).

Melia azedarach

MELIACEAE

White Cedar

Life history

Growth form: Small to medium-sized deciduous tree, usually with alternate bi-pinnate leaves, and 3–5 pairs of opposite leaflets.

Vegetative spread: No.

Longevity: 70–100 years.

Primary juvenile period: 5 years.

Flowers: Lilac, chocolate-scented, October–November.

Fruit/seed: Yellowish fleshy egg-shaped fruit 10–15 mm long, with hard-coated centre containing 5 seeds, mature March–May. 1480 fruit/kg and 4215 seeds/kg (Floyd 1989).

Dispersal, establishment & growth: Diaspore: fruit, bird-dispersed, fruit reported from pellets of Currawongs (Buchanan 1989a). No soil-stored seedbank, fresh seed germinates without treatment after 2 months in soil. Germination 95%, slow, 11–16 weeks (Floyd 1989), 3–8 weeks (A. Bofeldt pers. comm.).

Fire response: Resprouted from base after high intensity fire (1/94) at Lane Cove (P. Kubiak pers. comm.).

Interaction with other organisms: Foodplant of moth larvae *Leptocneria binotata* and *L. reducta*, defoliating the trees (Common 1990) mainly in autumn (Hadlington & Johnston 1977). Host plant of Cerambycid beetle *Coptopterus thoracicus* (Hawkeswood 1993), and Auger Beetle *Bostrychopsis jesuita* (Jones & Elliot 1986).

Seed eaten by Sulphur-crested Cockatoo *Cacatua galerita*, Australian King Parrot *Alisterus scapularis*, Crimson Rosella *Platycercus elegans* (Lepschi 1993). Reported to cause death of pigs and fowls but not native birds (Whittet 1958) also poisonous to dogs and man but eaten by Emerald Dove Figbird, Lewins Honeyeater, Pied Currawong, Bowerbirds, Wompoo Fruit Dove, Wonga Pigeon (Floyd 1989), Olive-backed Oriole, Noisy Friarbird, Green Catbird, Rose-crowned Fruit Dove (M. Robinson pers. comm.). Fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC *NWS CWS; Qld, W.A., to Asia.

Distribution Sydney area: Nepean River, Illawarra.

Select locations: CC: Cattai, Kurrajong, Penrith, Razorback, Picton, Mt Keira, Albion Park, Macquarie Pass, Minnamurra Falls.

Habitat

Habitat: Levee banks, rocky slopes, gullies.

Altitude: 0–250 m

Annual rainfall: 700–1400 mm

Typical local abundance: Occasional.

Vegetation: Riparian forest, subtropical and dry rainforest e.g. with *Melicope micrococca*, on margins and in regrowth,

Substrate: Sandy alluvium and clay soils from shales, medium nutrients, watertable mostly low, moisture supply intermittent, fresh.

Exposure: Light shade to full sun (A. Bofeldt pers. comm.).

Conservation

Conservation: Occurs naturally along Hawkesbury–Nepean River and in Illawarra, but birds spread it into bushland from gardens in other areas of Sydney (McDonald 1993). Riverine and dry rainforest habitats poorly conserved. Reported from Macquarie Pass NP, Budderoo NP, Killalea SRA (A. Bofeldt & M. Robinson pers. comm.). Widely cultivated as a shade tree (inland districts especially).

Synoum glandulosum

MELIACEAE

Scentless Rosewood

Life history**Growth form:** Shrub or small tree to 7 m high.**Vegetative spread:****Longevity:** Long**Primary juvenile period:****Flowers:** White to pinkish, January–August, peak March–May.**Fruit/seed:** Capsule 10–15 mm long, usually 3-lobed; seed 6 mm diameter with bright orange fleshy aril. Mature September–January (L. Parkinson pers. comm.).**Dispersal, establishment & growth:** Diaspore: seed with fleshy aril, vertebrate-dispersed (French & Westoby 1996), probably bird-dispersed. Germinates without treatment, seedling growth slow. Develops lignotuber in less than 5 years (A. Bofeldt & M. Robinson pers. comm.).**Fire response:** Resprouts from base after high-intensity fire (1/94) (at Katandra, Mona Vale (L. McD.), at Lane Cove, Narrabeen (P. Kubiak pers. comm.).**Interaction with other organisms:****Distribution****Status/origin:** Native.**Botanical subregions:** NC CC CT SC; Qld.**Distribution Sydney area:** Coast, more rarely plateau (P. Kodela pers. comm.).**Select locations:** CC: Olney SF, Ourimbah, Calga, Maroota, Berowra Creek, Narrabeen, Kurnell, Audley, Mt Keira, Minnamurra Falls, Foxground, Cambewarra. CT: Robertson (P. Kodela p.c.).**Habitat****Habitat:** Sheltered gullies, creek banks.**Altitude:** 0–700 m **Annual rainfall:** 1200–1600 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Warm temperate, subtropical, littoral rainforest e.g. with *Doryphora sassafras*, *Backhousia myrtifolia*; or riparian forest e.g. with *Eucalyptus piperita*, *Angophora costata*, *Callicoma serratifolia*.**Substrate:** Sandy loam on alluvium, sandstone with basalt influence, medium nutrients.**Exposure:** Light shade–full shade. Tolerates exposure (A. Bofeldt & M. Robinson pers. comm.).**Conservation****Conservation:** Conservation status unknown. Reported from Royal NP, Macquarie Pass NP, Illawarra SRA (A. Bofeldt & M. Robinson pers. comm.).***Toona ciliata***

MELIACEAE

Red Cedar

Life history**Growth form:** Medium to large deciduous tree with brown to grey scaly bark.

Domatia present on leaves as small hair-tufts.

Vegetative spread: No.**Longevity:** 100–200 years.**Primary juvenile period:****Flowers:** White, October–November.**Fruit/seed:** Capsule 10–20 mm long, with up to 25 winged seeds 13–18 mm long, ripe January–March. 200 000–300 000 seeds per kg (Floyd 1989).**Dispersal, establishment & growth:** Diaspore: seeds, probably wind-dispersed. Probably no soil-stored seedbank. Germination of seed is very rapid, from 7–28 days, with 68% germination (Floyd 1989).**Fire response:** Resprouts from base (A. Bofeldt pers. comm.).**Interaction with other organisms:** Host plant of Cerambycid beetle *Pachydissus sericus* (Hawkeswood 1993). Goliath or Rhinoceros beetles feed on the bark, host of Red Cedar Tip Moth *Hypsipyla robusta* (Elliot & Jones 1986).

Status/origin: Native.		Distribution
Botanical subregions: NC CC SC NT CT ST CWS; Qld, N.I., N.G., Indon.		
Distribution Sydney area: Widespread Illawarra, Kurrajong, Kowmung.		
Select locations: CC: Wyong Creek, Strickland SF, Otford, Mt Keira, Kangaroo Valley, Gerrington, Wheeny Creek, Grose Vale, Kowmung River. CT: Lannigans Creek.		
Habitat: Riverbanks, gullies.		Habitat
Altitude: 0–800 m	Annual rainfall: 1000–1400 mm	
Typical local abundance: Frequent–occasional.		
Vegetation: Subtropical and riverine rainforest, but also in warm temperate rainforest on alluvial soils.		
Substrate: Alluvial soils from shales and basalt, high fertility soils. Budgong Sandstone, Bumbo Latite, Quaternary alluvium in Illawarra (A. Bofeldt & M. Robinson pers. comm.).		
Exposure:		
		Conservation
Conservation: Once particularly abundant in the Illawarra area and a major timber tree last century. Few old trees survive. Reported from Budderoo NP, Illawarra Escarpment SRA, Macquarie Pass NP, Killalea SRA (A. Bofeldt & M. Robinson pers. comm.).		

***Melianthus major* ***

MELIANTHACEAE

Cape Honey Flower

		Life history
Growth form: Shrub to 4 m high.		
Vegetative spread:		
Longevity:		
Primary juvenile period:		
Flowers: Red or deep purple-brown, September–December.		
Fruit/seed: Capsule 30–40 mm long, with 8 shiny black seeds, November.		
Dispersal, establishment & growth:		
Fire response:		
Interaction with other organisms:		
		Distribution
Status/origin: Exotic, native to S Africa.		
Botanical subregions: CC NWS; Qld, S.A.		
Distribution Sydney area: Royal National Park.		
Select locations: CC: Royal NP (1973).		
Habitat: Old house site.		Habitat
Altitude: 0–100 m	Annual rainfall: 700–1400 mm	
Typical local abundance: Frequent.		
Vegetation:		
Substrate: Clay soils on shale.		
Exposure:		
		Conservation
Conservation: Cultivated as an ornamental, sometimes a garden escape.		

Legnephora moorei**MENISPERMACEAE**

Round-leaf Vine

Life history

Growth form: Woody climber, high in the canopy, often only noticed by the fallen grey-black leaves on the forest floor (Harden 1990).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Separate male and female flowers on different plants, summer.

Fruit/seed: Globular fleshy fruit 8–10 mm long. Blue–purple with glaucous covering (A. Bofeldt, T. Lewis pers. comm.).

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms: Foodplant of moth larvae *Othreis materna* and *O. fullonia* (Common 1990).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CWS; Qld.

Distribution Sydney area: Mainly coastal.

Select locations: CC: Ourimbah, Grose Vale, Razorback, Burning Palms, Albion Park, Kangaroo Valley, Jamberoo, Minnamurra River.

Habitat

Habitat: Steep gullies, riverbanks.

Altitude: 0–400 m

Annual rainfall: 700–1400 mm

Typical local abundance: Frequent–rare.

Vegetation: Moist rainforest; or dry rainforest e.g. with *Alectryon subcinereus*, *Ficus rubiginosa*.

Substrate: Clay soils on shale, sometimes on sandstone, medium nutrients. Quaternary alluvium, Budgong Sandstone, Bumbo Latite in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure:

Conservation

Conservation: Not known. Poorly conserved in Illawarra, reported from Macquarie Pass NP, Budderoo NP (A. Bofeldt & M. Robinson pers. comm.).

Sarcopetalum harveyanum**MENISPERMACEAE**

Pearl Vine

Life history

Growth form: Sprawling twiner to tall climber, dioecious, climbing up the trunks and sprawling over shrubs.

Vegetative spread: No.

Longevity:

Primary juvenile period:

Flowers: Red–yellow, male and female flowers on separate plants, September–December. Pollen 12.6–14.4 µm long, under-represented in the modern pollen rain (Kodala 1996).

Fruit/seed: Flattened red succulent fruit (drupe), 5–8 mm diameter, April–July.

Dispersal, establishment & growth: Diaspore: fleshy fruit, vertebrate-adapted dispersal (Westoby et al. 1990).

Fire response: Resprouted from base after high intensity fire (1/94) at Lane Cove and Narrabeen (P. Kubiak pers. comm.).

Interaction with other organisms: Foodplant of moth larvae *Eudocima salaminia*, and *Othreis fullonia* (Common 1990).

Distribution

Status/origin: Native.

Botanical subregions: NC CC CT SC CWS; Qld, Vic., N.G.

Distribution Sydney area: Widespread.

Select locations: CC: St Albans, Dora Creek, Eastwood, Vacluse, Cooks River (1892), Ingleburn, Bulli Pass, Shellharbour, Grose Vale, Cobbitty, Razorback. CT: Robertson.

Habitat

Habitat: Creek banks, gullies, coastal headlands, plateau.

Altitude: 0–750 m **Annual rainfall:** ~1600 mm

Typical local abundance: Frequent–occasional.

Vegetation: Moist rainforest e.g. with *Cassine australis*, *Sarcomelicope simplicifolia*, *Ficus obliqua* (Bass Point); mixed cool temperate/warm temperate rainforest e.g. with *Doryphora sassafras*, *Acmena smithii*, *Acacia uclauxylon* (Kodela 1990a); dry rainforest e.g. with *Streblus brunonianus*, *Ehretia acuminata*; open-forest e.g. with *Backhousia myrtifolia*, *Eleocarpus reticulatus*.

Substrate: Moderate–high fertility soils from basalt, shale, slate, sandstone, well-drained.

Bumbo Latite, Budgong Sandstone, Coal Measures, Quaternary alluvium in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure:

Conservation

Conservation: Conservation status unknown. Reported from Macquarie Pass NP, Budderoo NP, Illawarra Escarpment SRA (A. Bofeldt & M. Robinson pers. comm.).

Stephania japonica* var. *discolor**MENISPERMACEAE**

Snake Vine

Life history

Growth form: Slender climber with peltate leaves.

Vegetative spread: No.

Longevity:

Primary juvenile period:

Flowers: Male and female flowers on separate plants, November–April.

Fruit/seed: Fleshy, about 2–5 mm long, changing from green to yellow to red at maturity January–June.

Dispersal, establishment & growth: Diaspore: vertebrate-adapted fleshy fruit (Westoby et al. 1990), probably bird-dispersed.

Fire response: Resprouted from base after high intensity fire (1/94) at Lane Cove and Narrabeen, flowering within 1 year (P. Kubiak pers. comm.).

Interaction with other organisms: Foodplant of moth larvae *Calyptra minuticornis*, *Plusiodonta coelonota*, *Eudocima salaminia* and *Othreis fullonia* (Common 1990).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS; Qld, Asia.

Distribution Sydney area: Mainly coastal.

Select locations: CC: North Entrance, Gunderman, Cheltenham, Otford, Bass Point, Berry, Cobbitty, Razorback, St Helena. CT: Kowmung, Goodmans Ford.

Habitat

Habitat: Coastal dunes, moist gullies, creek banks, in or near rainforest.

Altitude: 0–700 m **Annual rainfall:** 700–1200 mm

Typical local abundance: Occasional–frequent.

Vegetation: Eucalypt open-forest e.g. floodplain tall open-forest with *Eucalyptus dcaniei*, *E. tereticornis*, *Angophora floribunda* (Scholer 1974), dry rainforest e.g. with *Brachychiton populneum*, *Alphitonia excelsa*, *Dendrocnide excelsa*; littoral rainforest e.g. with *Glochidion ferdinandi*, *Acmena smithii*, *Cupaniopsis anacardioides*; and coastal dune communities.

Substrate: Moderate fertility soils, on shale, volcanics, limestone, sand dune, watertable mostly low, intermittent, fresh.

Exposure: Light shade–full sun.

Conservation

Conservation: A widespread species probably reasonably conserved.

Nymphoides geminata

MENYANTHACEAE

Life history

Growth form: Aquatic annual or perennial herb, often tufted, with floating leaves to 5 cm diam.

Vegetative spread: Usually not stoloniferous.

Longevity: 1–3 years, possibly depending on length of inundation.

Primary juvenile period:

Flowers: Yellow, November–March.

Fruit/seed: Capsule 5–8 mm long, with black seeds 1 mm long. Capsule submerged at maturity, December–March.

Dispersal, establishment & growth: Diaspore: seed, probably ant-dispersed (Chuang & Ornduff 1992), probably also water dispersed. Seedlings establish in wet ground or shallow water (recorded in May at Agnes Banks). Adults appear to die out in dry periods leaving soil-stored seed for recruitment.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC NT CT ST NWP; Qld, Vic.

Distribution Sydney area: Western Sydney and Southern Highlands.

Select locations: CC: Agnes Banks, Glenfield, Narellan, The Oaks.

CT: Wingecarribee Swamp.

Habitat

Habitat: Ponds & margins of rivers, perennial or ephemeral pools, usually less than 1 m deep.

Altitude: 0–700 m **Annual rainfall:** 800–1600 mm

Typical local abundance: Occasional–frequent.

Vegetation: Fresh swamp e.g. with *Ludwigia peploides*, *Eleocharis equisetina*; or montane peatland e.g. with *Eleocharis sphacelata*, *Isolepis producta*, *Juncus articulatus*, *Potamogeton tricarlinatus*, *Ranunculus inundatus*.

Substrate: Low to medium nutrient sediments, fluctuating water level.

Exposure: Full sun.

Conservation

Conservation: Vulnerable in Western Sydney (Benson & McDougall 1991).

Nymphoides indica

MENYANTHACEAE

Water Snowflake

Life history

Growth form: Aquatic herb with floating, circular leaves to 30 cm diam. and stolons; stems to several metres long.

Vegetative spread: Floating stolons.

Longevity:

Primary juvenile period:

Flowers: White with yellow or orange at base, spring–autumn.

Fruit/seed: Capsule, with straw-coloured seed 1–2 mm long.

Dispersal, establishment & growth: Diaspore: seed, probably ant-dispersed (Chuang & Ornduff 1992), probably also water dispersed.

Fire response:

Interaction with other organisms: Foodplant of Grey Teal *Anas gibberifrons* seed eaten by Plumed Whistling Duck *Dendrocygna eytoni* (Barker & Vestjens 1989, 1990).

Distribution

Status/origin: Native.

Botanical subregions: NC CC; Qld, N.T., W.A., Asia, Afr., Amer.

Distribution Sydney area: Coast, north from Sydney.

Select locations: CC: Centennial Park (1979, 1985).

Habitat: Ponds & margins of rivers, still or flowing water to 2 m deep. Altitude: 0–50 m Annual rainfall: 1200 mm Typical local abundance: Vegetation: Substrate: Still and flowing water up to 2 m deep. Exposure:	Habitat
Conservation: Sydney is southern geographical limit. Conservation status unknown.	Conservation

Villarsia exaltata

MENYANTHACEAE

Growth form: Tufted perennial aquatic herb without stolons; leaves emergent, never floating, 6–15 cm long, thick-textured, matt-surfaced, typically ovate, stems to 1.5 m high. Vegetative spread: Longevity: Indefinite (D. Keith pers. comm.). Primary juvenile period: Flowers: Yellow, October–April, peak November. Fruit/seed: Dehiscent capsule 5–13 mm long, seeds 2–3 mm long, October–March. Dispersal, establishment & growth: Diaspore: seed, probably ant-dispersed (Chuang & Ornduff 1992), probably also water dispersed. Fire response: Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.), resprouted after high intensity fire (1/94) at Narrabeen, with seeds shed within 5 months (P. Kubiak pers. comm.). Interaction with other organisms:	Life history
Status/origin: Native. Botanical subregions: NC CC SC CT ST; Qld, Vic., Tas. Distribution Sydney area: Coast and Woronora Plateau Select locations: CC: Putty Road, Wyong, Gosford, Narrabeen, Botany Swamps (1914), Kogarah (1893), Kurnell, Maddens Plains, Thirlmere Lakes. CT: Wingecarribee Swamp, Fitzroy Falls.	Distribution
Habitat: Margins of lagoons and swampy areas with fluctuating water levels but not alluvial floodplains. Altitude: 0–700 m Annual rainfall: 900–1600 mm Typical local abundance: Frequent–occasional. Vegetation: Freshswamp; sedgeland e.g. with <i>Chorizandra</i>, <i>Leptospermum</i>, <i>Callistemon</i>; montane peatland e.g. with <i>Lythrum salicaria</i>, <i>Phragmites australis</i>, <i>Lysimachia vulgaris</i>. Substrate: Stationary or slow-flowing water to 50 cm deep in swamps or ephemeral pools. Low to medium nutrient sandy or peaty soils. Colonises low pH (2.5–6.5) acid sulphate estuarine soils in the Wyong area (Payne 1992). Exposure:	Habitat
Conservation: Probably adequately conserved on sandstone plateaus but not on coastal lagoons.	Conservation

Villarsia reniformis

MENYANTHACEAE

Life history

Growth form: Perennial aquatic herb, stoloniferous, at least in permanent water; circular leaves floating and emergent.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Yellow, October–January.

Fruit/seed: Capsule, seeds 1–2 mm long.

Dispersal, establishment & growth: Diaspore: seed, probably ant-dispersed (Chuang & Ornduff 1992), probably also water dispersed.

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC SC CT ST; Vic., Tas., S.A.

Distribution Sydney area:

Select locations: CC: Kogarah (1893), Coomonderry Swamp, Shoalhaven Heads.

CT: Wingecarribee Swamp

Habitat

Habitat: Swampy areas and wet sites.

Altitude: 0–700 m

Annual rainfall: 1100–1400 mm

Typical local abundance:

Vegetation: Freshwater swamp.

Substrate: In temporary or permanent pools in swamps or depressions. In water less than 50 cm deep on peaty, infertile soil. Watertable mostly high, non-saline.

Exposure:

Conservation

Conservation: Rare, only 3 records in the area and extinct at Kogarah.

Atherosperma moschatum

MONIMIACEAE

Black Sassafras, Southern Sassafras

Life history

Growth form: Shrub to medium-sized tree, with furrowed stems, sometimes multi-stemmed, leaves with a sweet-spicy scent when crushed.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: White or greenish with purple markings, August–October.

Fruit/seed: Cluster of densely hairy dry fruits, 10 mm long.

Dispersal, establishment & growth: Diaspore: fruit, probably wind-dispersed.

Fire response:

Interaction with other organisms: Foodplant of moth caterpillar *Boarmia corticola* and butterfly caterpillar *Graphium macleayanum* (Coupar & Coupar 1992).

Distribution

Status/origin: Native.

Botanical subregions: NT CT ST; Vic., Tas.

Distribution Sydney area: Upper Blue Mountains.

Select locations: CT: Lawson, Wentworth Falls, Leura, Blackheath.

Habitat

Habitat: Gullies near waterfalls.

Altitude: 900–1000 m

Annual rainfall: 1200–1400 mm

Typical local abundance: Rare to frequent.

Vegetation: Rainforest and creekbank scrub e.g. with *Callicoma serratifolia*, *Gleichenia*.

Substrate: Soils on sandstone, medium nutrients.

Exposure: Moist, sheltered sites.

Conservation

Conservation: Probably adequately conserved in Blue Mountains.

***Daphnandra* species A**

MONIMIACEAE

Socketwood

Life history

Growth form: Medium-sized tree, with hairy young shoots and leaves. Formerly included in *D. micrantha* (Harden 1990).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Pale green to whitish.

Fruit/seed: Woody fruit containing hairy achenes, takes 6–8 months to reach maturity (Harden 1990).

Dispersal, establishment & growth: Diaspore: achene, probably wind-dispersed.

Fire response:

Interaction with other organisms:

Distribution

Status/origin:

Botanical subregions: CC NC; Qld.

Distribution Sydney area: CC: Wattagan.

Select locations: CC: Wattagan.

Habitat

Habitat: Moist rocky gullies.

Altitude: 0–400 m

Annual rainfall: 1200–1400 mm

Typical local abundance:

Vegetation: Regenerating rainforest.

Substrate:

Exposure:

Conservation

Conservation: Wattagan is southern geographical limit. Conservation status unknown.

Daphnandra species C

MONIMIACEAE

Socketwood

Life history

Growth form: Tree to about 10 m high, with grey corky bark on larger trees. Leaves opposite, toothed, shiny, slightly aromatic with prominent veins on undersurface (Fuller & Mills 1985).

Vegetative spread: Probably capable of suckering (K. Mills pers. comm.).

Longevity:

Primary juvenile period:

Flowers: Small white, September.

Fruit/seed: Fruits brown, egg shaped covered with fine brown hairs (Fuller & Mills 1985).

Within a woody receptacle 5–7 mm long, taking about 6–8 months to mature (Harden 1990).

Dispersal, establishment & growth:

Fire response: Possibly killed by fire (K. Mills pers. comm.).

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: CC.

Distribution Sydney area: Illawarra area.

Select locations: CC: Albion Park, Kiama, Minnamurra River valley, Foxground, Jerrara, Gerroa.

Habitat

Habitat: Rocky hillsides and slopes.

Altitude: 0–300 m

Annual rainfall: 1200–1600 mm

Typical local abundance: Rare (K. Mills pers. comm.).

Vegetation: Dry subtropical rainforest (Mills 1988) e.g. with *Baloghia lucida*, *Acmena smithii*, *Cinnamomum oliveri* and disturbed edges of rainforest.

Substrate: Rocky soils on latite (volcanic) high nutrient soils, dry to moist (K. Mills pers. comm.). Most sites are quite dry although it is also known from the high rainfall zone at the head of the Minnamurra River valley (K. Mills pers. comm.).

Exposure: Full shade in rainforest to disturbed margins (K. Mills pers. comm.).

Conservation

Conservation: Very rare, coded 2VCI on national rare species list (Briggs & Leigh 1996), and the only rainforest tree endemic to Illawarra region (Mills 1988).

Southern geographical limit Gerroa, northern limit Stockyard Mountain. Reserved in Budderoo NP (Minnamurra Falls area).

Doryphora sassafras

MONIMIACEAE

Sassafras

Life history

Growth form: Tree to 20 m high, but often smaller and multi-stemmed and forming thickets; young shoots silky-hairy and all parts aromatic.

Vegetative spread: May form thickets, coppicing from base (P. Kodela pers. comm.).

Longevity: Long-lived.

Primary juvenile period:

Flowers: Whitish, peak August–September. Pollen 34.8–52.8 µm long, under-represented in the modern pollen rain (Kodela 1990b, 1996).

Fruit/seed: Hairy, ribbed fruit 10 mm long, splits to release hairy seeds, April–July.

Dispersal, establishment & growth: Diaspore: plumed seeds wind dispersed (Westoby et al. 1990).

Fire response:

Interaction with other organisms: Foodplant of butterfly caterpillar *Graphium macleayanum* (Coupar & Coupar 1992). Host plant of Cerambycid beetle *Coptopterus cretifer* (Hawkeswood 1993).

Distribution**Status/origin:** Native.**Botanical subregions:** NT CC SC NT CT ST CWS; Qld.**Distribution Sydney area:** Coast and Upper Blue Mountains, Robertson Plateau (P. Kodela pers. comm.).**Select locations:** CC: Boorai Creek, Wahroonga, Waterfall, Mt Keira, Cataract Creek, Macquarie Pass, Berry Minnamurra Falls, Kangaroo Valley. CT: Mt Coricudgy, Jenolan Caves, Mt Tomah, Mt Wilson, Wentworth Falls, Robertson, Wingello.**Habitat****Habitat:** Sheltered sites, along creeks, and plateau hillsides (rolling-undulating) (P. Kodela pers. comm.).**Altitude:** 0–1100 m **Annual rainfall:** 1000–1800 mm**Typical local abundance:** Frequent to dominant.**Vegetation:** Subtropical rainforest and mixed cool temperate/warm temperate rainforest e.g. with *Ceratopetalum apetalum*, *Acacia melanoxylon*.**Substrate:** Clay soils on basalt, shale, sandy alluvium, sometimes sandstone, medium to high nutrients. Watertable mostly low, well-drained.**Exposure:** Sheltered situations.**Conservation****Conservation:** Probably well conserved e.g. in Blue Mountains NP, Royal NP, Morton NP (K. Mills pers. comm.), Robertson NR (P. Kodela pers. comm.).***Hedycarya angustifolia*****MONIMIACEAE**

Native Mulberry

Life history**Growth form:** Thicketed shrub to small tree, often crooked with several basal stems, and coppicing readily (A. Bofeldt pers. comm.).**Vegetative spread:** No.**Longevity:** 20–50 years (A. Bofeldt pers. comm.).**Primary juvenile period:****Flowers:** Male and female flowers on separate plants, greenish, spicy, August–October. Pollen 27.6–40.8 µm, well- to over-represented in modern pollen rain (Kodela 1990a, b, 1996).**Fruit/seed:** Yellow succulent aggregate fruit 6–8 mm diam., with 22 seeds. Fruit weight 515 mg (extra data on seed & pulp characteristics in French 1991), ripe December–January.**Dispersal, establishment & growth:** Diaspore: fruit, probably bird-dispersed. Germination 3–6 weeks (A. Bofeldt pers. comm.).**Fire response:****Interaction with other organisms:** Fruit eaten by Pilotbird *Pycnoptilus floccosus* (Barker & Vestjens 1989, 1990). Fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT ST; Qld, Vic., Tas.**Distribution Sydney area:** Blue Mountains and Illawarra.**Select locations:** CC: Garie, Otford, Bulli, Minnamurra Falls, Bilpin, Springwood.

CT: Mt Coricudgy, Mt Tomah, Blackheath, Boyd Plateau, Mt Werong, Robertson, Foxground, Wingello, Wombeyan Caves.

Habitat**Habitat:** Moist mountain gullies.**Altitude:** 0–1100 m **Annual rainfall:** 1000–1400 mm**Typical local abundance:** Frequent–occasional.**Vegetation:** Temperate rainforest e.g. with *Acmena smithii*, *Doryphora sassafras*, *Synoum glandulosum*, *Callicoma serratifolia*; rainforest margins e.g. with *Eucalyptus fastigata*.**Substrate:** Sand to sandy loam and clay loam on basalt, shales, granite, metasediments, often rocky, medium to high nutrients, moist but well-drained.**Exposure:** Sheltered sites. Shade tolerant (A. Bofeldt pers. comm.).**Conservation****Conservation:** Probably adequately conserved.

Palmeria scandens

MONIMIACEAE

Anchor Vine

Life history

Growth form: Tall woody climber, with stellate-hairy stems. Often shrubby under a dense canopy (K. Mills pers. comm.).

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Whitish, male and female flowers on separate plants, June–August.

Fruit/seed: Green false fruit 15–20 mm diam., splits at maturity to reveal 3–7 clustered fleshy red fruit.

Dispersal, establishment & growth: Diaspore: fleshy fruit, vertebrate-adapted for dispersal (Westoby et al. 1990).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC CT SC NT; Qld.

Distribution Sydney area: Coastal ranges.

Select locations: CC: Calga, Gosford, Maroota, Bayview (L.McD.), Waterfall, Cataract Creek, Bulli Pass, Mt Keira, Macquarie Pass, Broughton Mountain, Minnamurra Falls. CT: Robertson (P. Kodala p.c.).

Habitat

Habitat: Coastal rainforest.

Altitude: 0–650 m

Annual rainfall: 1200–1600 mm

Typical local abundance: Occasional–frequent.

Vegetation: Mainly warm temperate rainforest (K. Mills pers. comm.); subtropical rainforest e.g. with *Doryphora sassafras*–*Ceratopetalum apetalum*, *Cryptocarya glaucescens*, *Acmea smithii*, *Sloanea australis*, *Eupomatia laurina*; gully rainforest e.g. with *Tristanopsis laurina*, *Ceratopetalum apetalum*, *Callicoma serratifolia*.

Substrate: Basalt or volcanic soil, high nutrients. Watertable mostly low, moisture supply intermittent, fresh. Wet locations (K. Mills pers. comm.). Colluvium, alluvium, Budgong Sandstone, Coal Measures in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Sheltered situations; mid-shade.

Conservation

Conservation: Adequately conserved in Illawarra, reported from Macquarie Pass NP, Budderoo NP, Illawarra SRA, (A. Bofeldt & M. Robinson pers. comm.). Conservation status elsewhere unknown.

Wilkiea huegeliana

MONIMIACEAE

Veiny Wilkiea

Life history

Growth form: Shrub or tree to 4 m high. 12 m high at Comerong Island in Illawarra (A. Bofeldt pers. comm.).

Vegetative spread: No.

Longevity: Long-lived (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Summer. Male and female flowers often on different trees.

Fruit/seed: Fleshy black fruit 7–12 mm diam., mature April–August (L. Parkinson pers. comm.).

Dispersal, establishment & growth: Diaspore: fleshy fruit, adapted for vertebrate dispersal (Westoby et al. 1990). Germination 6–12 weeks (A. Bofeldt pers. comm.).

Fire response: Possibly killed after high intensity fire (1/94) at Narrabeen (P. Kubiak pers. comm.). Other reports of resprouting after fire.

Interaction with other organisms:

Status/origin: Native.

Botanical subregions: NC CC SC NT; Qld.

Distribution Sydney area: Coast.

Select locations: CC: Narara Creek, Patonga Creek, Barrenjoey, Newport, Kogarah (1900), Helensburgh, Otford, Bass Point, Kiama, Saddleback.

Habitat: Gullies, slopes.

Altitude: 0–400 m

Annual rainfall: above 1200 mm

Typical local abundance: Occasional.

Vegetation: Subtropical to warm temperate rainforest, dry rainforest e.g. with *Acmena smithii*, *Guioia semiglaucula*, *Diospyros* sp., *Streblus brunonianus*, *Aphanopetalum resinosum*; and moist tall open-forest e.g. with *Eucalyptus pilularis*, *Syncarpia glomulifera*.

Substrate: Sandy loam from Narrabeen formation, volcanics (in Illawarra), medium nutrients. Watertable mostly low, moisture supply intermittent. Latite, Budgong Sandstone, alluvium in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Sheltered situations; mid shade.

Distribution

Habitat

Conservation

Conservation: Conservation status unknown. Reported from Macquarie Pass NP, Budderoo NP, Royal NP, Comerong NR (A. Bofeldt & M. Robinson pers. comm.).

Ficus coronata

Creek Sandpaper Fig, Sandpaper Fig

MORACEAE

Life history

Growth form: Scrambling or erect shrub or small tree to 15 m; upper surface of leaves rough and sandpapery.

Vegetative spread: Layering (A. Bofeldt & M. Robinson pers. comm.).

Longevity: Probably long.

Primary juvenile period:

Flowers: Tiny flowers within a globose receptacle (fig or syconium), pollinated by wasps of family Agaonidae (Zona 1995). November–July.

Fruit/seed: Fleshy edible fruit (fig), 20 mm long, purple black when mature, January–June, commonly borne on old branches or directly on main trunk and may be held on tree for long periods. Within the fruit are many seeds, ca. 1 mm diam., 3.4 million seeds/kg (Floyd 1989).

Dispersal, establishment & growth: Diaspore: fruit. Dispersed by birds or flying foxes (at Gordon). Probably no dormancy mechanism or soil-stored seedbank.

Fire response: Small plant resprouted from base after high intensity fire (1/94) at Lane Cove (P. Kubiak pers. comm.).

Interaction with other organisms: Fig sweet and edible, eaten by Figbird, Green Catbird, Olive-backed Oriole, Grey-headed Flying Fox; Aboriginal people used leaves as sandpaper for smoothing weapons (Floyd 1989). Fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995).

Status/origin: Native.

Botanical subregions: NC CC SC NT CT ST NWS CWS; Qld, Vic., N.T.

Distribution Sydney area: Coast and adjacent plateaus and valleys of Blue Mountains.

Select locations: CC: Yarramalong, Eastwood, Grose Vale, Warragamba, Bola Creek, Cambewarra. CT: Blackheath, Kowmung River, Colong.

Habitat: Creek banks, in rainforest and open country, or sheltered rocky areas.

Altitude: 0–1000 m

Annual rainfall: above 1000 mm

Typical local abundance: Frequent–occasional.

Vegetation: Warm temperate rainforest; subtropical rainforest e.g. with *Dendrocnide excelsa*, *Pennantia cunninghamii*; and moist open-forest often along creek banks.

Substrate: Various, sandstone boulders, clayey to sandy soil, Silurian limestone at Colong Caves, medium to low nutrient soils. Well drained; moisture supply intermittent, fresh.

Exposure: Sheltered situations, light shade.

Habitat

Conservation

Conservation: Conserved in Illawarra, reported from Macquarie Pass NP, Budderoo NP, Illawarra Escarpment SRA (A. Bofeldt & M. Robinson pers. comm.).

Conservation status elsewhere unknown.

Ficus fraseri**MORACEAE**

Sandpaper Fig

Life history**Growth form:** Shrub to medium-sized tree; leaves rough on both surfaces.**Vegetative spread:** No.**Longevity:** More than 100 years.**Primary juvenile period:****Flowers:** Tiny flowers within a globose receptacle (fig or syconium), pollinated by wasps of family Agaonidae (Zona 1995).**Fruit/seed:** Egg-shaped fig 10–15 mm long, yellow turning orange-red, ripe May–February. Seeds 1 mm diam., 2.8 million seeds per kg (Floyd 1989). Sporadic, does not fruit every year (R. Payne pers. comm.).**Dispersal, establishment & growth:** Diaspore: fig, dispersed by Figbirds (R. Payne pers. comm.), possibly dispersed by bats (Herb. specimen). Probably no seed dormancy or soil-stored seedbank. Germination 3–9 weeks (A. Bofeldt pers. comm.).**Fire response:****Interaction with other organisms:** Host plant of Cerambycid beetle *Coptopterus decoratus* (Hawkeswood 1993). Figs eaten by Regent Bowerbird, pigeons, doves etc. (Floyd 1989). Figbirds congregate on fruiting trees at North Entrance (R. Payne pers. comm.). Fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC; Qld, N. Cal.**Distribution Sydney area:** North from Tuggerah Lakes.**Select locations:** CC: North Entrance.**Habitat****Habitat:** Littoral rainforest.**Altitude:** 0–100 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Rare.**Vegetation:** Littoral rainforest e.g. with *Cupaniopsis anacardioides*, *Syzygium paniculatum*, *Guioa semiglaucula*, *Banksia integrifolia*, *Leptospermum laevigatum* (at North Entrance) (R. Payne pers. comm.).**Substrate:** Black sandy soil on Quaternary sanddunes, low nutrients, well-drained.**Exposure:** Shade-tolerant (A. Bofeldt pers. comm.).**Conservation****Conservation:** Tuggerah Lake is the southern geographical limit (Harden 1990).

Young plants have been reported from Gordon bat colony (Herb. specimen), possibly dispersed by bats. Whether these will survive to maturity in the eucalypt forest there is unknown.

Population at North Entrance threatened by road widening (R. Payne pers. comm.).

Ficus macrophylla* subsp. *macrophylla

MORACEAE

Moreton Bay Fig

Life history

Growth form: Large spreading tree up to 40 m high, often with buttressing. A 'strangler' fig (A. Bofeldt pers. comm.).

Vegetative spread: No.

Longevity: Long (more than 100 years).

Primary juvenile period:

Flowers: Tiny flowers within a globose receptacle (fig or syconium), pollinated by wasps of family Agaonidae (Zona 1995).

Fruit/seed: Round fig, orange turning purple 20–25 mm diameter. Ripe mainly February–May (Floyd 1989).

Dispersal, establishment & growth: Diaspore: fig, main fruit drop beneath canopy, distance dispersal by Flying Foxes, birds. Germinates as epiphyte or lithophyte sometimes 10 m above ground (evidently light-sensitive) and sends roots to ground; these subsequently strangle the host.

Fire response:

Interaction with other organisms: Susceptible to defoliation by psyllids, particularly when under stress by drought, root damage etc; eggs are laid on leaf margins, larvae burrow into latex ducts and are protected by latex while sucking nutrient (B. Summerell pers. comm.). The small slug-like larvae of *Lactura caminaea* can defoliate, usually in spring (Hadlington & Johnston 1977). Host plant of beetle *Agrianome spinicollis* (Hawkeswood 1992a).

Aboriginal people used the fibre for fishing nets (Floyd 1989). Fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995). Substrate for *Bulbophyllum minutissimum* (A. Bofeldt & M. Robinson pers. comm.).

Distribution

Status/origin: Native, widely cultivated.

Botanical subregions: NC CC; Qld.

Distribution Sydney area: Illawarra and south to Shoalhaven River (K. Mills pers. comm.).

Select locations: CC: Mt Keira, Albion Park (M. Robinson p.c.), Saddleback Mountain, Budderoo NP, Cambewarra (K. Mills pers. comm.).

Habitat

Habitat: Dry to moist subtropical rainforest.

Altitude: 0–300 m **Annual rainfall:** 1200–1800 mm

Typical local abundance: Rare–occasional (K. Mills pers. comm.).

Vegetation: Subtropical and dry rainforest and riparian forest, often as an emergent.

Substrate: High nutrient soils on Budgong Sandstone, Bumbo Latite and alluvium in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure:

Conservation

Conservation: Preservation of rainforest remnants in the Illawarra necessary for the conservation of this species, reported from Macquarie Pass NP, Killalea SRA, Berkely NR, though rare and poorly conserved. Extensively grown as an ornamental in Sydney city area though such trees are often attacked by the fig psyllid which causes a white latex-like exudate.

Ficus obliqua

MORACEAE

Small-leaved Fig

Life history**Growth form:** Medium to large strangling tree with massive trunk to 40 m high.

Thick glabrous leaves 3–13 cm long.

Vegetative spread: No.**Longevity:** Long 500–1000 years (A. Bofeldt pers. comm.).**Primary juvenile period:****Flowers:** Tiny flowers within a globose receptacle (fig or syconium), pollinated by wasps of family Agaonidae (Zona 1995).**Fruit/seed:** Fig 6–10 mm diameter, orange–red with dark red spots when ripe. Can fruit throughout the year (A. Bofeldt pers. comm.).**Dispersal, establishment & growth:** Diaspore: fig, animal/bird-dispersed. Germinates as epiphyte or lithophyte and sends roots to the ground, subsequently strangling its host.**Fire response:****Interaction with other organisms:** Fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995), Satin Bower Bird, Topknot Pigeon, Lewins Honeyeater (M. Robinson pers. comm.).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC CWS; Qld, Malesia.**Distribution Sydney area:** Coast, mostly along the Illawarra Escarpment south to Mt Dromaderry (K. Mills pers. comm.).**Select locations:** CC: Gosford, Vacluse, Mt Keira, Clifton, Shellharbour, Minnamurra Falls, Berry Mountain.**Habitat****Habitat:** Escarpment slopes and benches, gullies.**Altitude:** 0–200 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Rare–occasional.**Vegetation:** Moist subtropical to warm temperate rainforest and littoral rainforest, commonly as an emergent. Moist high nutrient soils (K. Mills pers. comm.).**Substrate:** High nutrient soils. Budgong Sandstone, Bumbo Latite, Cambewarra Latite, Bass Point Sandstone in Illawarra (A. Bofeldt & M. Robinson pers. comm.).**Exposure:****Conservation****Conservation:** Preservation of rainforest remnants on Illawarra necessary for protection of this species, reported for Macquarie Pass NP and Budderoo NP (M. Robinson pers. comm.).***Ficus pumila* ***

MORACEAE

Creeping Fig

Life history**Growth form:** Woody creeper with hairy young stems.**Vegetative spread:** Spreading by adventitious roots.**Longevity:****Primary juvenile period:****Flowers:** Tiny flowers within a globose receptacle (fig or syconium), pollinated by wasps of family Agaonidae (Zona 1995).**Fruit/seed:** Fig 40–50 mm long, grey to mauve.**Dispersal, establishment & growth:****Fire response:** Limited resprouting after low intensity fire (1/94) at Lane Cove, possibly killed by high intensity fire (P. Kubiak pers. comm.).**Interaction with other organisms:****Distribution****Status/origin:** Exotic, native to Japan, China. Cultivated as ornamental.**Botanical subregions:** CC.**Distribution Sydney area:** Sydney Harbour suburbs.**Select locations:** CC: Bantry Bay (L.McD.), Clontarf (1959).

Habitat**Habitat:** Walls, rockfaces, sandstone slopes.**Altitude:** 0–100 m**Annual rainfall:** 1200–1400 mm**Typical local abundance:** Occasional.**Vegetation:** Old garden sites.**Substrate:** Sandy soils on sandstone, low nutrients.**Exposure:** Full sun.**Conservation****Conservation:** Widely cultivated, especially as a climber on walls and fences. Occurs around Sydney Harbour as escape from cultivation.***Ficus rubiginosa*****MORACEAE**

Port Jackson Fig, Rusty Fig

Life history**Growth form:** Large or small, spreading tree or shrub. Underside of leaves usually densely downy, often rust-coloured. May be deciduous or partially deciduous in spring though the taxon is extremely variable and further studies are required (Harden 1990).**Vegetative spread:** No.**Longevity:** Long, more than 100 years.**Primary juvenile period:****Flowers:** Tiny flowers within a globose receptacle (fig or syconium), pollinated by wasps of family Agaonidae (Zona 1995).**Fruit/seed:** Yellowish fig 4–10 mm diameter. Fruiting sporadic, ripe fruit shed July 97 (at Pittwater) unripe fruit on other trees. Sporadic fruiting (D.H.B.). 4.3 million seeds/kg (Floyd 1989).**Dispersal, establishment & growth:** Diaspore: fig, main fruit drop below canopy, distance dispersal by birds. Fruit reported from pellets of Currawongs (Buchanan 1989a), possibly also dispersed by Flying Foxes. Germinates and establishes as lithophyte (very rarely epiphytic). Often re-establishes on disturbed sites, brick-retaining walls etc. in urban areas. Evidently light-dependent.**Fire response:** Resprouted after high intensity fire (1/94) at Lane Cove and Narrabeen, fruiting within 2.7 years (P. Kubiak pers. comm.).**Interaction with other organisms:** Trees in Royal Botanic Gardens Sydney virtually defoliated by psyllids on various occasions, particularly in late spring. Fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT NWS CWS NWP; Qld.**Distribution Sydney area:** Widespread.**Select locations:** CC: Bilpin, Hornsby, Epping, Cremorne, Georges River, Razorback, Shellharbour, Minnamurra Falls. CT: Rylstone, Jenolan Caves, Blackheath, Mittagong, Wombeyan.**Habitat****Habitat:** Crevices and cliffines, often near the sea. Rocky sides of inlets and gullies.**Altitude:** 0–1000 m**Annual rainfall:** 600–1400 mm**Typical local abundance:** Occasional.**Vegetation:** Eucalypt open-forest or dry, littoral or rarely subtropical rainforest.**Substrate:** Rocky hillsides on sandstone, basalt, quartzite, low nutrients, but possibly with additional nutrients e.g. calcium (A. Rodd). Also latite in the Illawarra (K. Mills pers. comm.), and Budgong Sandstone (A. Bofeldt & M. Robinson pers. comm.). Well-drained sites.**Exposure:****Conservation****Conservation:** Likely to be adequately conserved. Main occurrences in the Illawarra not reserved (K. Mills pers. comm.).

Ficus superba* var. *henneana

MORACEAE

Deciduous Fig

Life history

Growth form: Tree to 40 m high, more or less deciduous, losing some or all of its leaves in late winter (or early spring but not every year, usually every 2–3 years, A. Bofeldt pers. comm.).

Vegetative spread: No.

Longevity: Very long-lived (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Tiny flowers within a globose receptacle (fig or syconium), pollinated by wasps of family Agaonidae (Zona 1995).

Fruit/seed: Globular fig 15–25 mm diameter, purple with pale spots. Mature mainly January–July, 2.07 million seeds/kg (Floyd 1989).

Dispersal, establishment & growth: Diaspore: fig, animal/bird-dispersed; or water-dispersed, germination 3–8 weeks (A. Bofeldt pers. comm.). A strangler which germinates as epiphyte or lithophyte and sends roots to the ground, subsequently strangling its host.

Fire response: Killed (A. Bofeldt pers. comm.).

Interaction with other organisms: Fruit eaten by birds e.g. Figbird, Lewin's Honeyeater, Regent Bowerbird (Floyd 1989), Topknot Pigeon (K. Mills pers. comm.) and Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995), White-headed Pigeon, Red-whiskered Bulbul (M. Robinson pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC; Qld, N.T.

Distribution Sydney area: Coast.

Select locations: CC: Calga, Bronte (1989), Cronulla, Burning Palms, (Calderwood and Berkeley: Fuller 1980), Shellharbour, Albion Park, Jamberoo, Minnamurra Falls.

Habitat

Habitat: Rocky creekbanks and slopes.

Altitude: 0–400 m

Annual rainfall: 1200–1400 mm

Typical local abundance: Rare–occasional (K. Mills pers. comm.), frequent in Illawarra (A. Bofeldt pers. comm.).

Vegetation: Littoral rainforest or dry rainforest e.g. with *Alectryon subcinereus*, *Alphitonia excelsa* (A. Bofeldt & M. Robinson pers. comm.), also rocky escarpments in eucalypt forest (K. Mills pers. comm.).

Substrate: Rocky soils on volcanics, sandstone, alluvium, high nutrients. Budgong Sandstone, Bumbo Latite member, Bass point Sandstone, Blow Hole Latite Member, Hawkesbury Sandstone, alluvium in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Exposure: Full sun to mid shade (A. Bofeldt pers. comm.).

Conservation

Conservation: Southern geographical limit is Yattetyattah NR (SC), although it is very rare south of the Shoalhaven River (K. Mills 1996). Inadequately conserved in Illawarra (A. Bofeldt pers. comm.). Conservation status elsewhere not known.

Maclura cochinchinensis

MORACEAE

Cockspur Thorn

Life history**Growth form:** Woody climber or straggling shrub with spines to 2.5 cm long.**Vegetative spread:** Vigorous suckering after clearing (or fire) (A. Bofeldt & M. Robinson pers. comm.).**Longevity:** More than 50 years (A. Bofeldt & M. Robinson pers. comm.).**Primary juvenile period:****Flowers:** Small, male and female flowers on separate plants, November–December.**Fruit/seed:** Round yellow to orange aggregate fruit, 1–2 cm diam., January–March.**Dispersal, establishment & growth:** Diaspore: fleshy fruit, probably spread by birds (K. Mills pers. comm.). Seed with short viability 1–2 months, germination 2–5 weeks (A. Bofeldt & M. Robinson pers. comm.).**Fire response:** Suckers vigorously (A. Bofeldt & M. Robinson pers. comm.).**Interaction with other organisms:** Fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995), provides nesting sites for birds (A. Bofeldt & M. Robinson pers. comm.).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC; Qld, Malesia.**Distribution Sydney area:** Coast and adjacent ranges.**Select locations:** CC: Calga, Grose Vale, Cobbitty, Kurnell, Cronulla, Albion Park, Kiama, Foxground, Cambewarra, Church Creek.**Habitat****Habitat:** Rainforest, open-forest (A. Bofeldt pers. comm.).**Altitude:** 0–600 m**Annual rainfall:** 700–1600 mm**Typical local abundance:** Occasional–frequent.**Vegetation:** Dry rainforest e.g. with *Streblus brunonianus*, *Alectryon subcinereus*, *Aphanopetalum resinosum*; or *Cassine australis* (A. Bofeldt pers. comm.); coastal scrub e.g. with stunted *Angophora costata*, *Eucalyptus robusta*. Often a compact shrub in paddocks (K. Mills pers. comm.).**Substrate:** Clay soils on shale, basalt, humus sand, low to high nutrients, well-drained to poorly drained. Common on volcanic soils in the Illawarra (K. Mills pers. comm.).**Exposure:** Full sun to mid shade (A. Bofeldt pers. comm.).**Conservation****Conservation:** Probably inadequately reserved in the Illawarra (K. Mills pers. comm.).

Reported from Macquarie NP, Budderoo NP, Berkely Is NP, Illawarra SRA, but dry rainforest habitat is poorly conserved in Illawarra (A. Bofeldt & M. Robinson pers. comm.).

Conservation status elsewhere unknown.

***Maclura pomifera* ***

MORACEAE

Osage Orange

Life history

Growth form: Deciduous tree 10–15 m or tall shrub, with stout spines 1–5 cm long.

Can be pruned to any size from 2 m and trained into a spiky hedge (Brookes 1995).

Vegetative spread: Suckers.

Longevity: More than 50 years (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Small yellow, male and female flowers on separate plants (Brookes 1995).

Fruit/seed: Yellowish-green, globular aggregate fruit 10–15 cm diam., with poisonous milky latex.

Dispersal, establishment & growth: Diaspore: fruit, possibly dispersed by floodwaters.

Germination 2–5 weeks (A. Bofeldt pers. comm.).

Fire response:

Interaction with other organisms: Timber yellowish, fine-grained, heavy (L.McD.).

American Indians valued its extremely tough wood for bows, used for wagon axles by pioneers, root and bark yield yellow dye (Murphy 1990).

Distribution

Status/origin: Exotic, native to N America. Cultivated as ornamental and used as 'live fence'; seed and plants sold in Australia after 1860 (Brookes 1995).

Botanical subregions: CC NWS CWS.

Distribution Sydney area: Sporadic.

Select locations: CC: Peats Crater (Hawkesbury River) (L.McD.), Bents Basin (1976), Menangle (A. Bofeldt p.c.).

Habitat

Habitat: Old farming sites.

Altitude: 0–200 m **Annual rainfall:** 900–1100 mm

Typical local abundance: Frequent.

Vegetation:

Substrate: Clayey soil from diatremes, medium nutrients, well-drained (A. Bofeldt pers. comm.).

Exposure: Full sun, can stand most conditions including drought, cold, wind and heat (Brookes 1995).

Conservation

Conservation: Locally naturalised around early settlements e.g. at Peats Crater in Muogamarra NR where a row of trees may have been used as a 'live fence' (L.McD.).

Remnant row of hedge trees at the Old Parsonage at Bungonia (Brookes 1995).

Uncommon and unlikely to invade bushland.

Malaisia scandens

MORACEAE

Burny Vine

Life history

Growth form: Woody climber with milky latex, or shrub at juvenile stage.

Vegetative spread: Suckering and layering (A. Bofeldt pers. comm.).

Longevity: Long-lived (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Inconspicuous creamish-white, male and female flowers, November–February; pollen expelled ballistically in sunlight for possible wind pollination; bees *Trigona carbonaria* and wasps *Polistes humilis* occasionally visiting male flowers (Williams & Adam 1993).

Fruit/seed: Red fleshy fruit 5–8 mm long.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC; LHI, Qld, N.T., Malesia, SE Asia, Pac. Is.

Distribution Sydney area: Illawarra.

Select locations: CC: Waterfall, Mt Kembla, Lake Illawarra, Albion Park (1977), Gerroa, Jamberoo, Minnamurra Falls, Cambewarra (K. Mills p.c.).

Habitat

Habitat: Warmer rainforest, often on rocky sites (K. Mills pers. comm.).

Altitude: 0–200 m **Annual rainfall:** 1200–1400 mm

Typical local abundance: Frequent.

Vegetation: Subtropical to warm temperate rainforest, clumped in light gaps, and along watercourses and rainforest margins (Williams & Adam 1993).

Substrate: Rocky soils on basalt, alluvium, sand, including Coal Measures, Bumbo Latite, Budgong Sandstone, Bass Point Sandstone in Illawarra (A. Bofeldt & M. Robinson pers. comm.), high nutrients, well-drained.

Exposure: Mid shade to full sun.

Conservation

Conservation: Probably well conserved in the national parks of the Illawarra, Macquarie Pass NP, Budderoo NP (K. Mills pers. comm.), though dry rainforest habitats poorly conserved (A. Bofeldt & M. Robinson pers. comm.).

***Morus alba* ***

MORACEAE

White Mulberry

Life history

Growth form: Tree or shrub with milky latex.

Vegetative spread:

Longevity:

Primary juvenile period:

Flowers: Separate male and female flowers on same or different plants.

Fruit/seed: Multiple, fleshy fruit 2–3 cm long, usually black, edible.

Dispersal, establishment & growth: Diaspore: fruit, bird-dispersed. Fruit reported from pellets of Currawongs (Buchanan 1989a).

Fire response: Resprouted from base after high intensity fire (1/94) at Lane Cove and Narrabeen, fruiting within 1 year (P. Kubiak pers. comm.).

Interaction with other organisms: Cultivated for fruit, leaves used to feed silkworms.

Distribution

Status/origin: Exotic, native to E Asia. Introduced for horticulture.

Botanical subregions: CC.

Distribution Sydney area: Sydney suburbs.

Select locations: CC: Cheltenham (1987), Northbridge (1965).

Habitat

Habitat: Creekbanks and gullies.

Altitude: 0–200 m **Annual rainfall:** 1100–1200 mm

Typical local abundance: Rare–occasional.

Vegetation: Disturbed riparian vegetation e.g. with *Ceratopetalum apetalum*, *Callicoma serratifolia*.

Substrate: Sandy soils on alluvium and sandstone, low–medium nutrients.

Exposure:

Conservation

Conservation: Widely cultivated, sometimes naturalised along creekbanks.

Streblus brunonianus

MORACEAE

Whalebone Tree

Life history

Growth form: Tall shrub or tree with milky latex; branches with scars from fallen stipules. Toothed leaves with rough undersurface.

Vegetative spread: Occasional suckering (A. Bofeldt pers. comm.).

Longevity: More than 75 years (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Inconspicuous greenish white, in dense spikes, November–February, male and female flowers on separate plants. Ballistic expulsion of pollen release in sunlight for possible wind pollination; bees *Trigona carbonaria* and wasps *Polistes humilis* occasionally recorded visiting male flowers (Williams & Adam 1993).

Fruit/seed: Yellow to red fleshy fruit 6 mm long, mature January–April, 6150 fruit/kg and 69400 dried seed per kg (Floyd 1989). Fruit sweet, edible (A. Bofeldt pers. comm.).

Dispersal, establishment & growth: Diaspore: fleshy fruit, bird-dispersed.

Short viability 1–3 months, germination 1–6 weeks (A. Bofeldt pers. comm.), germination 41%, after 45–53 days (Floyd 1989).

Fire response: Generally killed, but can resprout (A. Bofeldt & M. Robinson pers. comm.).

Interaction with other organisms: Small birds attracted to fruit (A. Bofeldt pers. comm.).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CT; Qld.

Distribution Sydney area: Coast and coastal ranges.

Select locations: CC: Mt Yengo, Cattai, Cobbitty, Razorback, Mt Kembla, Albion Park, Bass Point, Minnamurra Falls, Kiama, Cambewarra.

Habitat

Habitat: Rocky slopes, dry gullies, rainforest.

Altitude: 0–1000 m **Annual rainfall:** 700–1600 mm

Typical local abundance: Occasional–frequent (K. Mills pers. comm.).

Vegetation: Understorey species in subtropical rainforest e.g. with *Sarcomelicope simplicifolia*, *Cassine australis*, *Ficus obliqua*; dry rainforest e.g. with *Alectryon subcinereus*, *Cassine australis*, *Geijera latifolia*.

Substrate: Clay soils on shale, basalt, alluvium, medium–high nutrients, well-drained. Volcanic soil in the Illawarra (K. Mills pers. comm.).

Exposure:

Conservation

Conservation: Vulnerable in Western Sydney (Benson & McDougall 1991). Probably not adequately conserved in the Illawarra (K. Mills pers. comm.) where dry rainforest in particular is poorly conserved (A. Bofeldt & M. Robinson pers. comm.). Conservation status elsewhere unknown.

Eremophila debilis

MYOPORACEAE

Winter Apple, Amulla

Life history

Growth form: Prostrate, spreading shrub to 1 m diam., with a thick rootstock.

Vegetative spread: No.

Longevity:

Primary juvenile period:

Flowers: White to pale mauve, September–June.

Fruit/seed: White to reddish purple fleshy fruit 7–10 mm long, at any time.

Dispersal, establishment & growth:

Fire response: Resprouts from rootstock.

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC NT CT NWS CWS SWS NWP SWP; Qld, N.Z.

Distribution Sydney area: Cumberland Plain.

Select locations: CC: Wilberforce, Grose Vale, Marsden Park, Wentworthville, Bankstown, Liverpool, Glenfield, Camden, Glen Davis. CT: Crudine (1903).

Habitat

Habitat: Woodland.

Altitude: 0–700 m

Annual rainfall: 600–900 mm

Typical local abundance: Frequent–occasional.

Vegetation: Grassy woodland e.g. with *Eucalyptus moluccana*, *E. crebra*, *E. tereticornis*, *E. fibrosa*, *Theinoda australis*, *Bursaria spinosa*, *Acacia falcata*.

Substrate: Clay soils on Wianamatta Shale, occasionally on Tertiary alluvium, medium nutrients, well-drained.

Exposure: Full sun (M. Robinson pers. comm.).

Conservation

Conservation: Conservation status unknown.

Myoporum acuminatum**MYOPORACEAE****Life history**

Growth form: Glabrous shrub or small tree with corky bark.

Vegetative spread: No.

Longevity: 20–80 years (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: White with purple spots, June–September.

Fruit/seed: Ovoid, purplish-black, 5–7 mm long, July–December.

Dispersal, establishment & growth: Diaspore: seed with woody coat, germination slow and erratic, 2–6 months (A. Bofeldt pers. comm.).

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC; Qld.

Distribution Sydney area: Coast.

Select locations: CC: Tuggerah, Gosford, Mooney Mooney Creek, Botany (1889), Rockdale (1902), Albion Park, Bass Point, Jamberoo, Berry.

Habitat

Habitat: Coastal rainforest and open-forest.

Altitude: 0–300 m

Annual rainfall: 1200–1400 mm

Typical local abundance: Occasional.

Vegetation: Littoral, dry rainforest e.g. with *Acronychia oblongifolia*, *Diospyros australe*; open-forest e.g. with *Eucalyptus tereticornis*, *E. globoidea*, *E. bosistoana*; and low forest e.g. with *Casuarina glauca*, *Banksia integrifolia* forest near estuaries.

Substrate: Clay loam soils on shale, alluvium, medium nutrients. Sand, Budgong Sandstone, Latite in Illawarra (A. Bofeldt pers. comm.).

Exposure: Sheltered sites. Full sun to mid-shade (A. Bofeldt pers. comm.).

Conservation

Conservation: Conservation status unknown.

Myoporum bateae**MYOPORACEAE****Life history**

Growth form: Sweet-scented glabrous shrub to 4 m high.
Vegetative spread: No.
Longevity: Probably 10–30 years (A. Bofeldt pers. comm.).
Primary juvenile period:
Flowers: White or pale purplish pink, spring–summer.
Fruit/seed: Cream-coloured thinly fleshy (A. Bofeldt pers. comm.), 2–3 mm long.
Dispersal, establishment & growth:
Fire response: Probably killed (A. Bofeldt pers. comm.).
Interaction with other organisms:

Distribution

Status/origin:
Botanical subregions: SC CC ST.
Distribution Sydney area: Mainly Illawarra.
Select locations: CC: Erskine Creek, Marshall Mountain, Johnsons Spur, Yellow Rock (A. Bofeldt p.c.).

Habitat

Habitat: Warm rocky slopes.
Altitude: 0–200 m **Annual rainfall:** 1000–1200 mm
Typical local abundance: Rare–frequent.
Vegetation: Eucalypt forest/rainforest ecotone e.g. with *Eucalyptus tereticornis*, *Croton verreauxii*.
Substrate: Clay loam, Budgong Sandstone, Coal Cliff Sandstone, Coal Measures in Illawarra (A. Bofeldt & M. Robinson pers. comm.).
Exposure:

Conservation

Conservation: Erskine Creek (last collected 1899) is northern geographical limit. Only recently discovered in Illawarra where small populations are threatened by clearing, urban development, and grazing/agriculture (A. Bofeldt & M. Robinson pers. comm.). Not conserved.

Myoporum boninense* subsp. *australe**MYOPORACEAE**

Boobialla

Life history

Growth form: Glabrous shrub to 2 m high. Previously confused with *M. insulare* (Harden 1993).
Vegetative spread:
Longevity:
Primary juvenile period:
Flowers: White, March–August.
Fruit/seed: Fleshy fruit 5–10 mm long, June–August.
Dispersal, establishment & growth:
Fire response:
Interaction with other organisms:

Distribution

Status/origin: Native.
Botanical subregions: NC CC SC; Qld.
Distribution Sydney area: Coast.
Select locations: CC: Avoca, Bilgola, Wamberal, Dee Why, Castlecove, Manly, Newington, Rozelle (1888), Parramatta (1903), Wollongong, Gerringong, Minnamurra (P. Adam pers. comm.).

		Habitat
Habitat: Coastal cliffs, sand dunes.		
Altitude: 0–100 m	Annual rainfall: 1000–1400 mm	
Typical local abundance: Frequent–occasional.		
Vegetation: Windpruned coastal heath and dune scrub e.g. with <i>Leptospermum laevigatum</i> , <i>Acacia longifolia</i> , <i>Leucopogon parviflorus</i> , <i>Lomandra longifolia</i> . Occasionally in <i>Casuarina glauca</i> woodland (P. Adam pers. comm.).		
Substrate: Clay soil on shales, and sandy soils on sandstones, sand dunes, low nutrients.		
Exposure: Exposed to onshore winds. Sometimes adopts a low sprawling habit in very exposed sites; can grow in crevices on rocks or cliffs (P. Adam pers. comm.).		
Conservation:		Conservation

<i>Myoporum floribundum</i>		MYOPORACEAE
		Life history
Growth form: Sour-smelling, woody shrub to 3 m high.		
Vegetative spread:		
Longevity:		
Primary juvenile period:		
Flowers: White, September–October.		
Fruit/seed: Oblong, fleshy fruit, 2–3 mm long.		
Dispersal, establishment & growth:		
Fire response:		
Interaction with other organisms:		
		Distribution
Status/origin: Native.		
Botanical subregions: CC CT; Vic.		
Distribution Sydney area: Sporadic.		
Select locations: CC: Windsor (1914), Nepean River district (1897). CT: Hilltop (1992).		
		Habitat
Habitat: Rocky slopes.		
Altitude: 0–700 m	Annual rainfall: 700–900 mm	
Typical local abundance: Frequent–occasional.		
Vegetation: Open-forest e.g. with <i>Eucalyptus punctata</i> , <i>Allocasuarina torulosa</i> , <i>Acacia fimbriata</i> .		
Substrate: Sandy loam on sandstone, low nutrients, well-drained.		
Exposure:		
		Conservation
Conservation: Rare, coded 3RCi on national rare species list (Briggs & Leigh 1996). Windsor is northern geographical limit. Conservation status unknown.		

Myoporum montanum**MYOPORACEAE**

Western Boobialla, Water Bush

Life history**Growth form:** Glabrous shrub generally 1–4 m high.**Vegetative spread:** No.**Longevity:** 20–50 years (A. Bofeldt pers. comm.).**Primary juvenile period:****Flowers:** White with purple spots, May–September.**Fruit/seed:** Maroon, globular fleshy fruit 4–7 mm diameter, mature June–January.**Dispersal, establishment & growth:****Fire response:** Probably killed.**Interaction with other organisms:** Bees gather pollen and nectar (Clemson 1985).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CT NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic.**Distribution Sydney area:** Camden area, southern Blue Mountains.**Select locations:** CC: Nortons Basin, Razorback, Mt Annan, Menangle. CT: Jenolan Caves, Abercrombie Caves, Wombeyan Caves, Bowral, Bungonia Gorge.**Habitat****Habitat:** Hillsides, rocky creekbanks.**Altitude:** 0–1000 m**Annual rainfall:** 600–900 mm**Typical local abundance:** Rare–occasional.**Vegetation:** Woodland e.g. with *Eucalyptus moluccana*; *E. tereticornis* and grassy understorey; dry vine scrub e.g. with *Aphanopetalum resinosum*, *Celastrus subspicatus*, *Clerodendrum tomentosum*, *Cayratia clematidea*.**Substrate:** Clay soil on shale, possibly sites with calcium influence, well-drained, medium nutrients.**Exposure:** Light shade–full sun.**Conservation****Conservation:** Vulnerable in Western Sydney (Benson & McDougall 1991), conservation status elsewhere unknown.

Aegiceras corniculatum**MYRSINACEAE**

River Mangrove

Life history**Growth form:** Glabrous shrub or small tree mangrove to 4 m high with alternate leaves.

Salt glands, with salt crystals often visible on upper surface of leaves (P. Adam pers. comm.).

Lacks pneumatophores but shallow roots provide aeration in a similar way (West 1985).

Vegetative spread: No.**Longevity:** Long-lived (A. Bofeldt pers. comm.).**Primary juvenile period:****Flowers:** White, July–December (Clarke 1994). Honey bees and flies may be the main pollinators, with native bees and beetles playing a less significant role and butterflies a minor role (P. Kubiak pers. comm.). 14% mortality of flower buds due to burrowing insects (P. Clarke 1994).**Fruit/seed:** Elongated horn-shaped capsule 2–4 cm long germinating while still on the parent plant. Mature April–May (P. Clarke 1994).**Dispersal, establishment & growth:** Diaspore: Viviparous fruit, germinating while still on the parent plant, water-dispersed, tolerant of low light (Clarke & Hannon, 1971); can remain buoyant in seawater for up to 3 weeks, but under brackish conditions sink within a week; establishment takes 2 weeks to 3 months with less than 1% success possibly related to timing of propagule release in autumn (Clarke 1995).Less tolerant of high salinity than *Avicennia marina*, death of large numbers of plants occurred where encroachment of drift sand increased soil salinity in river swamps (Clarke & Hannon 1970). More than 30% of above ground productivity consistently allocated to formation of flowers and fruit with limited ability to produce new leaves after flowering; flush of new growth March–April (Clarke 1994).**Fire response:** Resprouted from base after high intensity fire (1/94) at Lane Cove, some plants killed (P. Kubiak pers. comm.). Resprouts from epicormic buds (at Breakfast Creek 1994 UNSW Hons. stud.). Killed by fire if crowns scorched but partially scorched trees appear to resprout from base of stem (at Jervis Bay, Clarke 1993).**Interaction with other organisms:** *Avicennia marina* would probably replace *Aegiceras corniculatum* in disturbed conditions but under long-term stable conditions the converse would apply (Clarke 1995). Larval host of Australian Jewel Beetle *Melobasis purpurascens* (Hawkeswood 1992b). Foodplant of moth larvae *Isotenes miserana* (Common 1990).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC; LHI, Qld, N.T., W.A., Pac. Is., Malesia, Asia.**Distribution Sydney area:** Coast, distribution patchy, southern limit Merimbula (P. Adam pers. comm.).**Select locations:** CC: Wisemans Ferry, Woy Woy Creek, Cowan Creek, Narrabeen, Lane Cove River, Quibray Bay, Georges River, Cabramatta Creek, Minnamurra River.**Habitat****Habitat:** Intertidal zone in estuaries.**Altitude:** 0–5 m**Annual rainfall:** 800–1400 mm**Typical local abundance:** Frequent–dominant.**Vegetation:** Mangrove scrub, usually with *Avicennia marina*.**Substrate:** Sandy and muddy sediments, on tidal flats. Most common in river swamps where salinity is usually lower than in bays, and at seaward edge of *Avicennia* where least opportunity for increase in salinity due to evaporation occurs and waterlogging is always high; extends further upstream than *Avicennia* (Clarke & Hannon 1970, Clarke 1995). Adult plants tolerant of water-logging. Complete saturation of soil favours *Aegiceras* (Clarke & Hannon 1970, Clarke 1994).**Exposure:** Full sun.**Conservation****Conservation:** Much of original habitat destroyed by landfill, and probably more vulnerable than *Avicennia marina* as less likely to colonise new sites. Protected by Fish Habitat Plan No 1 (P. Adam pers. comm.). Plants of low stature particularly susceptible to hydrocarbon pollutants (e.g. at Jervis Bay where most plants 60–80 cm high) and recovery slow with few propagules establishing (Clarke 1993).

Embelia australiana**MYRSINACEAE****Life history**

Growth form: Woody climber or a shrub at juvenile stage with zigzag branchlets.

Vegetative spread:

Longevity: Long-lived (A. Bofeldt pers. comm.).

Primary juvenile period:

Flowers: Spring.

Fruit/seed: Fleshy, blackish purple fruit 5–8 mm diam. with one seed.

Dispersal, establishment & growth:

Fire response:

Interaction with other organisms:

Distribution

Status/origin: Native.

Botanical subregions: NC CC; Qld.

Distribution Sydney area: Wyong.

Select locations: CC: Wyong (1978), Ourimbah Creek (R. Payne p.c.).

Habitat

Habitat: Gullies, sheltered slopes.

Altitude: 0–200 m

Annual rainfall: 1100–1200 mm

Typical local abundance: Rare (R. Payne pers. comm.).

Vegetation: Gallery rainforest (R. Payne pers. comm.).

Substrate: Alluvial sand, basalt, sandstone, medium nutrients.

Exposure: Mid to full shade (A. Bofeldt pers. comm.).

Conservation

Conservation: Wyong is southern geographical limit. Not conserved in Central Coast (R. Payne pers. comm.).

Rapanea howittiana**MYRSINACEAE**

Brush Muttonwood

Life history

Growth form: Shrub or small tree usually 5–10 m high, with smooth bark.

Vegetative spread: Suckers and coppices sometimes forming large suckering colonies (A. Bofeldt pers. comm.).

Longevity:

Primary juvenile period:

Flowers: Pale yellowish green, November–January (Floyd 1989).

Fruit/seed: Blue or mauve fleshy fruit 5–7 mm diam., ripe October–March.

Dispersal, establishment & growth: Dispersal: vertebrate-adapted fleshy fruit (Westoby et al. 1990). Germination 4–8 weeks (A. Bofeldt pers. comm.).

Fire response:

Interaction with other organisms: Fruit eaten by Rose-crowned Fruit Dove (Floyd 1989).

Distribution

Status/origin: Native.

Botanical subregions: NC CC SC CT ST CWS; Vic.

Distribution Sydney area: Widespread.

Select locations: CC: Ourimbah, Mangrove Creek, Lion Island, Little Cattai Creek, Kogarah (1896), Waterfall, Bass Point, Albion Park, Bargo River, Minnamurra Falls. CT: Mt Baker, Mt Wilson, Jenolan Caves, Robertson.

Habitat**Habitat:** Gullies, creekbanks.**Altitude:** 0–1000 m**Annual rainfall:** 1000–1600 mm**Typical local abundance:** Occasional.**Vegetation:** Littoral, subtropical and warm temperate rainforest or margins e.g. with *Eucalyptus pilularis*, *Syncarpia glomulifera*, *Acacia irrorata*; or coastal scrub e.g. with *Leptospermum laevigatum*, *Acacia longifolia*, *Viminaria juncea*.**Substrate:** Sandy soil on sandstone, alluvium, basalt, medium nutrients.**Exposure:** Full sun to mid-shade in Illawarra (A. Bofeldt & M. Robinson pers. comm.).**Conservation****Conservation:** Widespread but uncommon in Sydney area. Reported from Budderoo NP, Macquarie Pass NP, Illawarra SRA (A. Bofeldt & M. Robinson pers. comm.).
Conservation status unknown.***Rapanea variabilis*****MYRSINACEAE**

Muttonwood

Life history**Growth form:** Shrub or small tree, with teeth on some juvenile leaves.**Vegetative spread:** Appears to root-sucker and coppices.**Longevity:** Indefinite.**Primary juvenile period:****Flowers:** Creamy white, clustered along smaller branches, May–December, peak July.**Fruit/seed:** Purple fleshy fruit 4–6 mm diam., mature October–January.**Dispersal, establishment & growth:** Diaspore: fruit, vertebrate-adapted dispersal (Westoby et al. 1990). Germination 1–3 months (A. Bofeldt pers. comm.).**Fire response:** Resprouts e.g. from base after high intensity fire (1/94) at Lane Cove and Narrabeen, with flowers in bud in less than 2.5 years (P. Kubiak pers. comm.).**Interaction with other organisms:** Fruit eaten by Lewin's Honeyeater and Rose-crowned Fruit Dove (Floyd 1989). Host plant of Cerambycid beetle *Tessaromma sordidum* (Hawkeswood 1993).**Distribution****Status/origin:** Native.**Botanical subregions:** NC CC SC NT CWS; Qld.**Distribution Sydney area:** Widespread, coast and adjacent ranges.**Select locations:** CC: Mt Wareng, Wisemans Ferry, Eastwood, Nielsen Park, Towra Point, Wheeny Creek, Bents Basin, Razorback, Mt Keira, Bass Point, Minnamurra Falls.**Habitat****Habitat:** Moist forest and rocky gullies, drier slopes.**Altitude:** 0–500 m**Annual rainfall:** 700–1400 mm**Typical local abundance:** Occasional.**Vegetation:** Eucalypt open-forest e.g. with *Eucalyptus deanei*, *E. tereticornis*, *E. eugenioides*, *Syncarpia glomulifera*; dry rainforest, littoral rainforest and on coastal headlands e.g. with *Banksia integrifolia*.**Substrate:** Heavy soils on shales, volcanic necks, and enriched gullies on sandstone, medium nutrients. Narrabeen Series, Berry Siltstone, Budgong Sandstone, Bumbo Latite, Coal Measures in Illawarra (A. Bofeldt & M. Robinson pers. comm.).**Exposure:** Mid-shade to full sun.**Conservation****Conservation:** Probably adequate, conserved. Reported from Macquarie Pass NP, Budderoo NP, Illawarra Escarpment SRA, Killalea SRA, Berkeley Island NR (A. Bofeldt & M. Robinson pers. comm.).

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